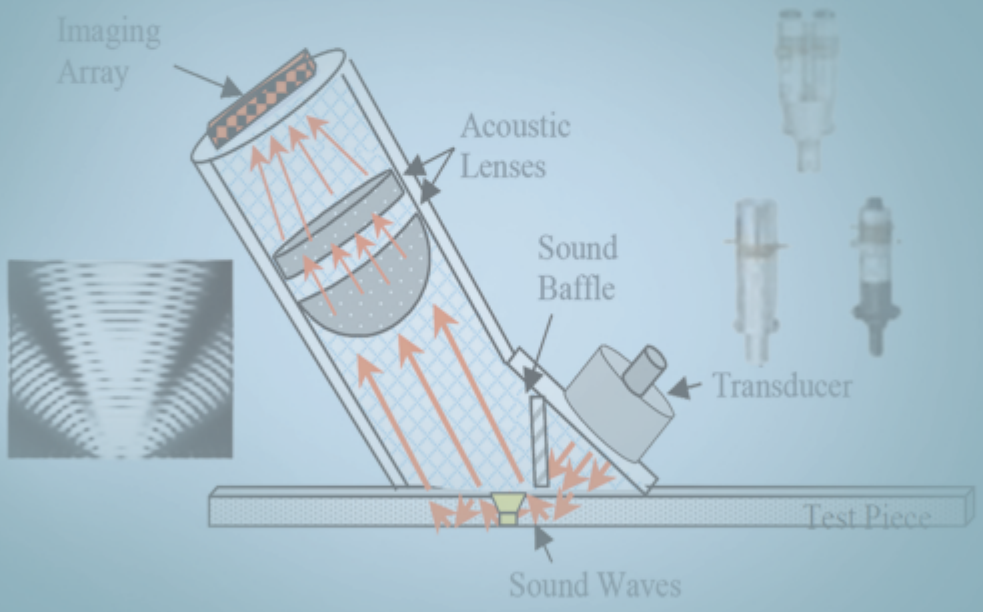
XXI[st] NATIONAL SYMPOSIUM ON ULTRASONICS

(NSU 2016)

08-10 November 2016



Late Abstracts

Organised by

S. N. Bose National Centre for Basic Sciences

Ultrasonics Society of India

Financial assistance received from -

S. N. Bose National Centre for Basic Sciences
Kolkata

Science and Engineering Research Board
New Delhi

Indian Council of Medical Research
New Delhi

Defence Research & Development Organization
New Delhi

Council of Scientific and Industrial Research

Bossa Nova Technologies, LLC
Bangalore

Bansal Diagnostics
Kolkata

ICON Analytical
Kolkata

Explore Discover.Resolve

XXIst National Symposium on
Ultrasonics (NSU-2016)

8-10th November, 2016

Abstracts & Programme

Organised by

Department of Condensed Matter Physics and Material Sciences,
S. N. Bose National Centre for Basic Sciences
&
Ultrasonics Society of India

National Advisory Committee

Prof. S. K. Ray *Director, SNBNCBS*	Dr. D. K. Aswal *Director, NPL*	Prof. V. Kumar *President, USI*
Prof. A. Sharma *Secretary, DST*	Prof. A. K. Mohanty *Director, SINP*	Prof. S. Raha *Director, BI*
Prof. E. S. R. Gopal *Ex-President USI, IISc Bangalore*	Dr. K. VijayRaghavan *Secretary, DBT*	Dr. S. Basu *Chairman AEC & Secretary DAE*
Dr. G. Sahni *DG, CSIR & Secretary, DSIR*	Prof. A. K. Raychaudhuri *Distinguished Professor, SNBNCBS*	Prof. S. K. Joshi *Ex-DG - CSIR*
Dr. Y. K. Yadav *General Secretary, USI*	Dr. V. R. Singh *Vice President 1, USI*	Prof. R. R. Yadav *Vice President 2,USI*

Organizing Committee

Prof. P. K. Mukhopadhyay	*SNBNCBS, Convenor*
Prof. Barnana Pal	*SINP, Co-Convener*
Dr. Tapas Paramanik	*SNBNCBS, Secretary*
Dr. Alo Dutta	*SNBNCBS, Treasurer*
Prof. Sugata Mukherjee	*SNBNCBS, Member*
Dr. Sampad Mukherjee	*IIEST, Member*
Prof. Sangam Banerjee	*SINP, Member*
Prof. Madhusadan Roy	*SINP, Member*

Ultrasonics Society of India

C/o Acoustics, Ultrasonics & Vibration (AUV) Section,
CSIR-National Physical Laboratory
Dr. K. S. Krishnan Marg, New Delhi - 110 012
Website : www.ultrasonicsindia.org

MESSAGE

Ultrasonic techniques are widely used in various fields of engineering and basic science. The ultrasound has applications in many spheres of societal importance in medicine, industrial processing, defence, robotics, materials characterization etc. An advantage of ultrasound is its capability to probe inside objects nondestructively because ultrasound can propagate through any kind of medium including solids, liquids and gases except vacuum. Accompanied by the rapid development of information processing technology, new fields of application, such as factory automation equipment and automotive electronics, are increasing and should continue to do so. The Ultrasonics Society of India has been contributing significantly to the promotion of research and teaching in ultrasonics and its applications and related areas by bringing together professionals and students periodically.

It is my honour to welcome the participants to the National Symposium on Ultrasonics (NSU-2016) which the Society is organizing jointly with the SN Bose National Centre of Basic Sciences. We are thankful to the Bose Centre for inviting the USI to hold the symposium here. The high quality of technical content can be seen from the list of speakers coming from premier institutions of India such as IISc TIFR, several IITs, NPL, NML, BHU IGCAR JNCSR, Allahabad, Nagpur, IIIT, and others as well as the Bose Centre itself. Over seventy contributed papers have been received from all over the country. I congratulate the organizing team for the logistical arrangements are reflected in the overwhelming response to the Symposium as more than a hundred delegates are expected to come here to participate.

On behalf of the Ultrasonic Society of India, I am particularly thankful to the Director SNBNCBS for extending all the support and facilities for this symposium. I would call upon the delegates to take maximum advantage of the deliberation at the Symposium, interact with experts in their respective fields of interest and enjoy a pleasant and comfortable stay at Kolkata.

Vikram Kumar
President, Ultrasonics Society of India
Emeritus Professor, CARE, IIT Delhi

Ultrasonics Society of India

C/o Acoustics, Ultrasonics & Vibration (AUV) Section,
CSIR-National Physical Laboratory
Dr. K. S. Krishnan Marg, New Delhi - 110 012 (INDIA)
Phone No. +91-11-45608415, 45609302; Fax: 91-11-4560 9310
E-mail: ykyadav6659@gmail.com; URL: http://www.ultrasonicsindia.org
Registration No. 11713-1981

MESSAGE

I feel proud, in fact, to write the message on occasion of XXI-National Symposium on Ultrasonics (XXI-NSU-2016). It is matter of great delight that this time the Symposium is being organized at *S.N. Bose National Centre of Basic Sciences, Kolkata* jointly by Department of Condensed Matter Physics & Material Sciences and *Ultrasonic Society of India (USI),* during 8-10 November, 2016.

I am happy to see the good response of the Symposium which received 79 research papers, 21 invited lectures in addition to the plenary talks covering wide field of ultrasonics with special sessions on Medical, NDE and Novel applications. I extend my heartfelt greetings to all the participants and organizers. I am sure the participants will be benefitted from symposium. I would like to thank SNBNCBS and organizing committee members for their hard work to bring the symposium a grand success.

Yudhisther Kumar Yadav
General Secretary, Ultrasonic Society of India
AUV Section, CSIR-NPL New Delhi

Foreword

It is a pleasure to us to welcome you in the XXIst. National Symposium on Ultrasonics, NSU16, in S.N.Bose National Centre of Basic Sciences, Kolkata, to be held from 8th. November to 10th. November, 2016. It is being hosted as an annual event of the Ultrasonics Society of India, including its General Body meeting. We are grateful to the participants to come forward in numbers, and send us communications in so many varied topics in the area of ultrasonics.

Ultrasonics as a general and versatile tool has a lot of uses in the lab, especially for the Condensed Matter Scientists, starting from the humble and ubiquitous ultrasonic cleaner to measurements for structural relaxations in solids, liquids and soft matters in kHz to MHz range. The spectroscopy of elastic and anelastic properties are of great theoretical and experimental interest. Equally important areas are constantly coming up – like sonochemistry. In case of engineers, it has invaluable use in detection of existing flaw and looking for future problem areas – in short characterizing material in a non destructive way. In case of marine exploration, probe and defense, use of ultrasonic sonar is a must. These are just a tip of the iceberg for the whole gamut of uses for ultrasonics in the inanimate world. We are sure you will enrich yourself in attending talks and posters of experienced researchers and young scientists alike.

Apart from these, it is also used as non photonicXray for visualizing the invisible contents inside our bodies, in non invasive way. Its use is invaluable in the case of detection of malfunctioning of cardiovascular systems, soft tissues and matter in abdomen etc., and even in the eye. We are happy to have among us some eminent physicians who directly work with the measurements and interpretation of the data – just for our wellbeing. We are sure you will learn a lot from their presentations.

Conforming to the idea, or belief, that ultrasonics touches various aspects in our lives, we endeavor to make a bouquet of presentations for the symposium. We hope you will go home with some new idea or information back from here.

We place our record appreciation for the help, encouragement and financial assistance from our the then Director, Prof. Sibaji Raha for the symposium to

start with. Prof. Arup Raychaudhuri of our department was always ready for any help or advice whenever we needed them. Prof. Samit Kr. Ray, the present Director of our centre was euqallly enthusiastic to see to it that we are able to conduct the symposium smoothly. The help and support from our administration was absolutely necessary from the word go. Further, the support and guidance of USI executive members, Prof. V. Kumar and Dr. Y. K. Yadav are hereby gratefully recorded. Finally it was Prof. R. R. Yadav who called us up with a request to hold the symposium here, with a express view to get more people interested into the beautiful world of ultrasonics, and his constant encouragement, is also hereby gratefully acknowledged.

The month of November is usually a pleasant month in Kolkata, with moderate temperatures and rather drier. However, in this month sometimes we do get cyclones in the Bay of Bengal – with accompanying rain and gale. This is unpredictable so far, and at this time the weather prediction being good, we hope that you will not be inconvenienced much. We expect you to have a pleasant stay here.

P. K. Mukhopadhyay and B. Pal

(Convenors)

XXIst National Symposium on Ultrasonics (NSU-2016)

Programme

Day 1, 8th November 2016 (Tuesday)

08:15 to 09:30	**Registration**	
09:30 to 10:25	**Inauguration**	
09:30 to 09:40	Welcome Address	Prof. S. K. Ray, *Director, SNBNCBS*
09:40 to 09:50	A few words about USI	Prof. V. Kumar, *President, USI*
09:50 to 09:55	Vote of Thanks	Prof. P. K. Mukhopadhyay, *Convener*
09:55 to 10:25	Keynote Address	Prof. E. S. R. Gopal, *Emeritus Professor, IISc* (New Challenge For Ultra-precise Sound Velocity Mesurements; Towards Redefining Temperaure)
10:25 to 10:45	**Tea time**	
10:45 to 13:00	**Session I**	**Physical Acoustics**
	Chairperson - Prof. V. Kumar, *President USI*	
10:45 to 11:10	Invited talk 1	Dr. Y. K. Yadav, *NPL* (Primary Standard on Ultrasonic Power Measurement for Medical Transducers and Associated Uncertainty)
11:10 to 11:35	Invited talk 2	Prof. S. K. Biswas, *IIT-Mohali* (Diagnosing Soft Matter by Listening to the Sound of Light.)
11:35 to 12:00	Invited talk 3	Prof. R. K. Saha, *IIIT-Allahabad* (Green's function approach for computation of photoacoustic fields from different nonspherical axisymmetric particles)

12:00 to 12:15	Oral presentation 1	B. K. Sreedhar (Computation of erosion potential of cavitation bubble in an ultrasonic pressure field)
12:15 to 12:30	Oral presentation 2	K.K. Pandey (Ultrasonic Attenuation at High Temperatures in Palladium metal)
12:30 to 12:45	Oral presentation 3	G. Suresh (Development of two dimensional sensor arrays for Underwater Acoustic Imaging)
12:45 to 13:00	Oral presentation 4	B. Pouet (Toward Remote Shear Wave Inspection)

13:00 to 14:00 Lunch time

14:00 to 16:30 Session II NDT & NDE 1

Chairperson – Dr. A. Mitra, *NML*

14:00 to 14:30	Plenary talk 1	Prof. K. Balasubhramanium, *IIT/Madras* (Ultrasonic Waveguide based Sensing and Measurements)
14:30 to 14:55	Invited talk 4	Dr. A. Kumar, *IGCAR* (Ultrasonic Imaging at Different Length Scales)
14:55 to 15:20	Invited talk 5	Dr. S.Palit Sagar, *NML* (Non-linear ultrasonic for damage assessment of in-service components)
15:20 to 15:45	Invited talk 6	Prof. O. P. Chimankar, *Nagpur University* (Acoustic spectroscopy in Advanced Materials using Pulse Echo Technique)
15:45 to 16:00	Oral presentation 5	S. Rajendran, *TATA Steel* (Application of Ultrasonic Testing Technique as a Condition Monitoring Tool in Steel Industry)

16:00 to 16:15	Oral presentation 6	A. K. Metya (Study of Localized Deformation Using Nonlinear Ultrasonic Technique by Lamb Wave Mixing)
16:15 to 16:30	Oral presentation 7	M.K.Sahu (Application of second harmonic based ultrasonic signal analysis for evaluation of micro structural changes due to creep damage in Ni-based super alloy)

16:30 to 16:45 Tea time

16:45 to 18:00 Poster session -1

Chairperson – Prof. S. Mukherjee, *SNBNCBS*

18:00 – 19:00 USI GB Meeting

19:00 – 20:30 Dinner

Day 2, 9th November 2016 (Wednesday)

09:30 to 10:50 Session III Novel applications 1

Chairperson – Prof E. S. R. Gopal, *Emeritus Professor, IISc*

09:30 to 10:00	Plenary talk 2	Prof. S. Bhattacharyya, *TIFR* (Amorphous to amorphous transition in athermal particle rafts)
10:00 to 10:25	Invited talk 7	Prof. R.R. Yadav, *Allahabad University* (Ultrasonic Spectroscopy in Nanoparticles - Liquid Suspensions)
10:25 to 10:50	Invited talk 8	Prof. K. Biswas, *JNCASR* (Phonon transport and ultralow thermal conductivity in complex metal chalcogenides)

10:50 – 11:05 Tea time

11:05 to 13:15	**Session IV**	**Biomedical Applications**
	Chairperson – Prof. R. R. Yadav, *Allahabad University*	
11:05 to 11:30	Invited talk 9	Prof. V.R. Singh, *IMS/EMBS* (Recent Developments in Ultrasonic Sensors for U-health Care: Nano-cancer Technology)
11:30 to 11:55	Invited talk 10	Prof. S. Banerjee, *IIT/KGP* (An Embedded CW Doppler Ultrasonography System: Cloud to add Color)
11:55 to 12:10	Oral presentation 8	P.D.Bageshwar (Acoustic Transducer using Indigenously Developed (Tb,Dy)Fe_2 rods)
12:10 to 12:25	Oral presentation 9	M. Das (Interaction study of paracetamol with anti-arthritis drugs in protic solvent media- an ultrasonic study)
12:25 to 12:40	Oral presentation 10	S. P. Das (Molecular interaction of non-steroid anti-inflammatory drug aceclophenac with Leucine in DMSO medium: an ultrasonic study)
12:40 to 12:55	Oral presentation 11	M. Irfana (Ultrasound as a Tool to Measure Articulatory Dynamics And Direction of Coarticulation)
12:55 to 13:15	Oral presentation 12	M. Messaoudi (Recent Progress in Multi-detector Laser Ultrasonic Receiver for Industrial Measurements)
13:15 to 14:15	**Lunch time**	

14:15 to 17:00	**Session V**	**Medical Applications**
	Chairperson–Dr. A. Sadhu, *Calcutta Medical College*	
14:15 to 14: 30	Oral presentation 13	Dr. S. Koley (Elastography, Speckle Reduction, Harmonic Imaging—Enhancing Image Quality and Extracting Additional Features for Improved Medical Diagnosis)
14:30 to 14:55	Invited talk 11	Dr. A. Maulik, Dr. Lal Path Labs (Echotexture of liver)
14:55 to 15:20	Invited talk 12	Dr. A.Sadhu, Calcutta Medical College (Sonomammography and Grey Areas)
15:20 to 15:45	Invited talk 13	Dr. D. Banerjee, AMRI Hospitals (Cardiac Ultrasound – the basics)
15:45 to 16:10	Invited talk 14	Dr. B. P. Chattopadhyay, *Calcutta Medical College* (Advanced Applications of Echo-Doppler Studies in the diagnosis of Heart disease)
16:10to 16:35	Invited talk 15	Dr. T. Sarkar, *Apollo Gleneagles Hospitals* (Sonographic interventions: walk in-walk out procedure)
16:35 to 17:00	Invited talk 16	Dr. A. Biswas,Alo Eye Care (Ophthalmic USG)

17:00 to 17:15 Tea time

17:15 to 18:15 Poster session II

Chairperson – Prof. M. Roy, *SINP*

19:00 to 21:00 Special Dinner

Day 3, 10th November 2016 (Thursday)

09:30 to 10:25	**Session VI**	**Sono Chemistry**
	Chairperson – Prof. S. Banerjee, *IIT/KGP*	
09:30 to 09:55	Invited talk 17	Prof. R. Paikaray, Ravenshaw University (A new horizon for dewaxing of crude oil: An ultrasonic approach)
09:55 to 10:10	Oral presentation 14	R. Varghese (Acoustical-assisted synthesis and characterization of Graphene nano sheets)
10:10 to 10:25	Oral presentation 15	A. Nandi (The Effects of Ultrasound: Bandgap Tailoring of ZnO)
10:30 to 11:20	**Session VII**	**NDT & NDE 2**
	Chairperson – Dr. S. Palit Sagar, *NML*	
10:30 to 10:55	Invited talk 18	Prof. P. Palanichamy, IGCAR (Microstructural Characterisation in Structural Materials and Residual Stress Evaluation in Weld Joints using Ultrasonics)
10:55 to 11:20	Invited talk 19	Prof. D. Singh, Amity University (Ultrasonic Behaviour of Condensed Materials At Different Physical Conditions)
11:30 to 13:05	**Session VIII**	**Novel applications 2**
	Chairperson - Dr. P. Palanichamy, IGCAR	
11.30 to 11:55	Invited talk 20	Dr. M. Singh, *NPL* (Acoustic performance of walls made with sustainable and industrialized dry construction panels)
11:55 to 12:20	Invited talk 21	Prof. S. K. Jain, *NorthCap University* (Some recent developments in force monitoring/ actuation using piezo-electrics and ultrasonics)

12:20 to 12:35	Oral presentation 16	K. Sakthipandi (On-line Ultrasonic Characterisation of Ni_2MnSn Heusler Alloys)
12:35 to 12:50	Oral presentation 17	B. K. Sreedhar (Design and Analysis of Ultrasonic Horn for Cavitation Generation in Liquid Sodium)
12:50 to 13:05	Oral presentation 18	P. K. Yadawa (Elastic and ultrasonic properties of hexagonal intermetallic ternary compound)

13:05 to 14:00 Lunch time

14:00 to 14:30 Session VIII Novel applications 3

Chairperson - Dr. Y. K. Yadav, *NPL*

14:00 to 14:15	Oral presentation 19	J. Poongudi (Study of Thermodynamic Properties in Binary Liquid Mixtures Through Ultrasonic Measurement)
14:15 to 14:30	Oral presentation 20	M. Palit Acoustic Transducer using Indigenously Developed $(Tb,Dy)Fe_2$ rods

14:30 to 15:30 **Valedictory Session**

Poster sessions:

PS-I : Abs. 1-19

PS-II : Abs. 1-10

Contents

KEYNOTE AND PLENARY TALKS

INVITED TALKS

ORAL PRESENTATION

POSTER SESSIONS

KEYNOTE
AND
PLENARY TALKS

Keynote 1

New Challenge for Ultra-precise Sound Velocity Mesurements; Towards Redefining Temperaure

E. S. Raja Gopal

Department of Physics, Indian Institute of Science, Bangalore 560 012
(E-mail: gopal@physics.iisc.ernet.in)

High accuracy sound velocity measurements are now providing a possibility of a new paradigm of being able to redefine TEMPERATURE in terms of fundamental natural constants, instead of being dependent on the properties of some material. As specified now, temperature scales have originated from the freezing and boiling points of water (0 and 100^o C or 32 and 212^o F). The absolute Kelvin scale atarts at -273.16 C, with the triple point of water being a better fixed point. These are defined to five digits, namely to an accuracy of 1 part in 100,000. On the other hand time, electrical voltage, electrical resistance etc are defined to an acuuracy of about 1 part in a billion. This has become possible by relating the definition to fixed fundamental constants of nature rather than to the variable physical properties of some specified material.

Thus an international effort to define TEMPERATURE in terms of fundamental constants was started about five decades ago. Currently the most promising route is the sound velocity in a perfect monatomic gas of known molecular weight. This enables the universal gas constant R to be determined and hence the Boltzmann constant k. The difficulties and the progress in determining Bolzmann constant to an accuracy of 1 part in a million will be described. For example the efforts to measure sound velocity in argon gas at very low pressures, to simulate an ideal gas, introduce the problem of the propagation becoming isothermal rather than adiabatic, since the collisions among the molecules become rare and so thermal equilibrium is disturbed. Internal dimensions of the containers have to be determined with accuracies better than 1 in a million. The most recent measurements have reached an accuracy slightly better than one part in a million.

Thus in terms of the Boltzmann constant one can define TEMPERATURE to an accuracy of one in a million, which is 10 time more accurate than the present definition. Another set of independent measuremtns will have to be performed before a new definition is considered. Other issues in the possible re-defining of temperature will also be discussed.

PL 1

Ultrasonic Waveguide based Sensing and Measurements

Krishnan Balasubramaniam

Centre for Nondestructive Evaluation, Indian Institute of Technology-Madras, Chennai, India
(Email : balas@iitm.ac.in)

Ultrasonic waveguide based sensing and measurements, that permit robust measurements and sensing, will be discussed in more detail in the talk. The use of ultrasonic guided waves have several advantages including remote measurements, multi-modal nature allowing for measurement of different parameters, small footprint, low cost, multi-point measurements on the same waveguide and most importantly robustness. These inherent qualities of ultrasonic waveguide based sensing are particularly useful in industrial applications. One of the key application that will be described will be the measurement of E and G moduli of materials as a function of temperature over a wide range of materials. Knowing the moduli of the waveguide material as a function of temperature, the in-situ measurement of physical properties such as temperature, rheology, fluid level, etc. of the surrounding fluid material can be accomplished using several embodiments of the waveguides using the fundamental wave modes such as L(0,1) and T(0,1). In addition, it will be shown that under sodium imaging in large plant conditions can be performed using ultrasonic waveguides using the A0 modes. The same waveguide can also be used to measure vibration of immersed components in a power plant. Finally, several other applications including the use of ultrasonic waveguides to measure the quality of spot welds of small dimensions, resin flow rate and rate of cure of polymeric resins systems for RTM process, will be demonstrated. Both experimental and finite element models will be used in the work.

❖❖❖

PL 2

Amorphous to Amorphous Transition in Athermal Particle Rafts

S. Bhattacharya*

Department of Condensed Matter Physics and Materials Science, Tata Institute of Fundamental Research, Homi Bhabha Road, Mumbai 400-005, India
(Email : shobobh@gmail.com)

Particle rafts, consisting of a monolayer of athermal hydrophobic particles on water interacting via short-range repulsive and long-range attractive forces, are viewed as both elastic and granular media. We use the emergence of rigidity upon uniaxial compression in a Langmuir trough, complemented by direct video microscopy, as probes of possible transitions in this system. We find a novel amorphous to amorphous transformation as a function of the areal number density. The transition is accompanied by anomalies in both the longitudinal and the shear moduli, as well as by pronounced features in both f and z where f is the number of floppy modes and z is the mean coordination number. These anomalies share striking similarities with the Ehrenfest/Pippard anomalies for conventional thermodynamic phase transitions and with features postulated for the jamming phenomenon in athermal granular systems.

*In collaboration with Atul Varshney, A. Sane, P. Aswathi and Shankar Ghosh

❖❖❖

INVITED TALKS

IT 1

Primary Standard on Ultrasonic Power Measurement for Medical Transducers and Associated Uncertainty

Yudhisther Kumar Yadav

CSIR-National Physical Laboratory, New Delhi-110012
(E-mail: ykyadav6659@gmail.com)

Ultrasonics has wide range of application in the field of medical science such as in diagnosis, therapeutic use or in disintegration of stones. Applications in industries are like characterization of materials, nondestructive testing and evaluation of material and in underwater acoustic applications etc. Ultrasonic power measurement is an important parameter and play key role in biomedical as well as in industrial applications. The accurate, precise and repeatable measurements of output power assure the quality and patient safety by giving the exact exposure levels, in case where a potential risk exists to the patient.

There are number of techniques used for ultrasonic power measurement such as by using planner scanning, torsion balance, pressure measurement, calorimetric, using thermocouple, light diffraction, radiation force balance, etc. Radiation force measurement of ultrasonic power is termed as primary standard for ultrasonic power measurement and is based on the fact that incident acoustic energy acting on reflecting or absorbing target transfers momentum to this target. Momentum is measured as force which is spatial and temporal average acoustic power.

The work has been done and still continues globally to establish the standard methods of measurement of ultrasonic power in liquids in megahertz frequency range based on radiation force measurement using a gravimetric balance. Basic safety requirements for ultrasonic physiotherapy devices are identified and are given in some of international standards these also specify the need for acoustic power measurements with an uncertainty better than $\pm$ 15 %. We in India could achieve and established the method for power measurement using radiation force balance with an uncertainty of $\pm$ 4.5 %. We indigenously have developed and are maintaining the Primary Standard of Ultrasonic Power

Measurement at NPL in the range of few mille watt to 10 W and in frequency range 0.5 to 15 MHz . The system consist NPL developed reflecting target as well as the absorbing target. NPL has been participating in the BIPM International Intercomparison of Ultrasonic Power for its competence for Calibration and Measurement Capabilities at International Level.

The measurement of acoustic power accurately, precisely and repeatable using a radiation force balance is the established reference method, but influenced by a number of practical problems and these constitute the component of measurement uncertainties. Paper presents the method and solution to the practical problems which influence the result of the measurement of ultrasonic power.

Key Words: Ultrasonic Power, biomedical ultrasonics, transducer, calibration, BIPM Inter comparison.

❖❖❖

IT 2

Diagnosing Soft Matter by Listening to the Sound of Light

Samir Kumar Biswas

Department of Physics, IISER, Mohali
(Email : skbiswas@iith.ac.in)

Light and ultrasound transport through living tissue are getting more important in recent research of biophysics and medical physics, mainly due to its potential application in non-destructive non-invasive diagnostic pathology. Using soft radiation like light and ultrasound, the tissue activities such as metabolism, blood flow in tissue can be quantified by correlating them with chromophores (haemoglobin, Melanin, water, lipid *etc.*). My talk will be physics of soft matter under non-ionized radiation for tissue parameter extraction where light-tissue and ultrasound-tissue interaction will be the matter of discussion. With advanced mathematics, physics of light and acoustic, the inside angiogenesis in human subjects will bring out under rheumatoid arthritis disease in human joints and other possibilities such as inflammation and so on will be discussed.

❖❖❖

IT 3

Green's function approach for computation of photoacoustic fields from different nonspherical axisymmetric particles

Ratan K. Saha

Department of Applied Sciences, Indian Institute of Information Technology Allahabad, Jhalwa, Deoghat, Allahabad 211012
(Email : ratank.saha@iiita.ac.in)

Photoacoustic (PA) field produced by a fluid sphere can be calculated exactly by solving the corresponding wave equation in frequency domain. Although the spherical approximation works well at low frequencies but fails at higher frequencies for many nonspherical particles of clinical interest [e.g. red blood cells (RBCs)]. Recently, we have computed the PA fields in the far field region for some nonspherical axisymmetric particles using Green's function approach. The shapes include spheroidal droplets, Chebyshev particles and normal (discocyte) and pathological (stomatocyte) RBCs. The corresponding PA spectra along and perpendicular to the direction of symmetry axis have been examined for each particle. It has been observed that features demonstrated by a spectral line depend upon the size of the particle and the direction of measurement. For instance, the first minimum of PA spectrum appears at 640 MHz for discocytes and 421 MHz for stomatocytes when computed from the direction of symmetry axis. The same feature occurs at 240 and 310 MHz, respectively for those particles when measured along the perpendicular direction. The numerical and published experimental results are in good agreement. The present approach is a simple and fast method, demonstrating that rapid characterization of cellular morphology from single-particle PA spectra may be possible.

❖❖❖

IT 4

Ultrasonic Imaging at Different Length Scales

Anish Kumar

Metallurgy and Materials Group, Indira Gandhi Centre for Atomic Research, Kalpakkam, Tamil Nadu-603102, India
(Email : anish@igcar.gov.in)

Ultrasonic imaging is one of the most versatile non-destructive evaluation tool for mapping of features of various dimensions. In the present paper, various ultrasonic methodologies developed in the author's laboratory towards ultrasonic imaging at different length scales viz. from meter to nm range are presented.

In sodium cooled fast breeder reactors, ultrasonic imaging is the only possible mean of viewing the components submerged in opaque sodium. The methodology developed and results obtained for 3D imaging of objects submerged in sodium will be presented. Specific methodologies and signal analysis approach developed for under sodium ultrasonic imaging for detection of protrusion of subassemblies in Prototype Fast Breeder Reactor (PFBR) will also be discussed. A glancing angle ultrasonic imaging based novel methodology for mapping of subassembly heads will also be presented.

Various ultrasonic imaging methodologies have been developed incorporating advanced techniques such as synthetic aperture focusing technique (SAFT), phased array ultrasonics, and time-frequency based analysis for imaging of defects in components. Advanced phased array based ultrasonic imaging with enhanced sensitivity and imaging capabilities will also be presented. A hybrid technique utilizing SAFT processing on phased array signals for enhanced focusing with limited phased array resource will also be presented.

Sub-wavelength ultrasonic imaging can be achieved by near field techniques. Atomic force acoustic microscopy (AFAM) is one such technique for mapping of elastic properties at the surface of a specimen with a lateral resolution of a few tens of nanometers. The applications of AFAM for mapping of elastic stiffness and damping in submicron size precipitates and second phases in various materials will also be discussed.

Keywords: Ultrasonic imaging, 3D viewing, phased array, atomic force acoustic microscopy

IT 5

Non-linear ultrasonic for damage assessment of in-service components

Sarmishtha Palit Sagar

Materials Science & Technology Division, CSIR-National Metallurgical Laboratory, Jamshedpur, India

(Email: sarmi@nmlindia.org)

Non-linear ultrasonic (NLU) is coming up as a potential non-destructive technique for the assessment of progression of damage in structural materials. CSIR-NML has initiated activities in the area of NLU from 2006 onwards. Applications of NLU to assess the most prominent damages in industrial components like fatigue, corrosion and creep are one of the niche research areas of CSIR-NML. An attempt has also been initiated to develop damage predictive model based on NLU parameter. a portable, site worthy NLU device (**Ultra β**) that can be used to monitor the damage of in-service structural components. Moreover the device comes with a software calb that can measure NLU parameter online.

This presentation will highlight our activities on fatigue and creep damage evaluation using non-linear ultrasonic.

❖❖❖

IT 6

Acoustic spectroscopy in Advanced Materials using Pulse Echo Technique

O. P. Chimankar

Department of Physics, RTM Nagpur University, Nagpur-440 033, India

(E-mail: opchimankar28@gmail.com, omprakash_chim@yahoo.co.in)

Ultrasonic non-destructive evaluations (NDE) are very useful procedures that can be applied to a range of materials for the characterization of their structures, the appraisal of defects and the determination of physical properties such as density, thermal conductivity and electrical resistivity. Recent development has found use of acoustic energy in medicines, engineering, agriculture and food technology. Non-destructive characterization methods using the ultrasonic have become very important technique to characterize the advanced materials and it may be a cost effective replacement of highly expensive SEM and TEM method up to some extent. It has become for any characterization scheme, study of ultrasonic propagation behavior in the materials at different physical/microstructural conditions is prerequisite. Now it has become possible to characterize the advanced biomaterials, nanostructured materials, nanocomposites, nanofluids/ferrofluids, drug-polymer suspension, food materials etc. Fundamental properties of the nanomaterials are strong function of their size and shapes. Size of the nanoparticles and their distribution are determined using the ultrasonic spectroscopy method.

Acoustic Theory for heterogenous system yield a relationship between some measured acoustic properties such as sound speed, attenuation, acoustic impedance, etc. and some microscopic characteristics such as its composition, structure, electric surface properties, particle size distribution, etc. Ultrasound attenuation in heterogenous system arises either from absorption and scattering. The absorption of ultrasound is easy to calculate unlike light scattering and is very important source of information about the particles, especially sub-micron particles and nano particles. Mismatch of density & compressibility play very important role in the study of scattered intensity of nano suspension. The known values of density and compressibility of nano suspension and

surrounding medium might be used to examine particle size determination by acoustic back scattering phenomena. The scattering of ultrasonic waves from the cluster of suspensions play very important role in medical field and in industries.

In the present talk some of the newer developments of ultrasonics & its applications in industry along with the underlying principles are highlighted and expected to induce interest among researchers for further work on these applications.

Keywords: Non destructive technique, attenuation, scattering, acoustic impedance, suspension.

❖❖❖

Ultrasonic Spectroscopy in Nanoparticles - Liquid Suspensions

R. R. Yadav*

Physics Department, UGC Center of Advanced Studies, University of Allahabad, Allahabad -211002, India

(E-mail: rryadav1@rediffmail.com)

Recently, the sound propagation through random media has also been a subject of great interest. Such media include colloidal suspensions, porous material, magnetorheological medium and nanofluids. The nanofluid is a colloidal suspension of the nanoparticles as the carriers in the fluids. The nanofluids have great interest due to a broad application in different fields such as thermal management technology. In the present study, ZnO nanoparticles and suspension of ZnO nanoparticles - ethylene glycol (EG) nanofluids have been prepared using the chemical method. The nanofluids were synthesized by the dispersion of ZnO nanoparticles in EG solution using an ultrasonicator. These materials are important for biosensing and coolant technology. Size of the nanoparticles and their distribution are determined using the ultrasonic spectroscopy method using acoustic particle sizer (APS-100). Temperature dependent anomalously enhanced thermal conductivity has been experimentally determined along with theoretical modeling using transient plane source method (TPS-500).

❖❖❖

IT 8

Phonon transport and ultralow thermal conductivity in complex metal chalcogenides

Kanishka Biswas

New Chemistry Unit, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Jakkur P.O., Bangalore 560064 (India)

(Email: kanishka@jncasr.ac.in)

Thermoelectric materials can directly and reversibly convert waste heat into electrical energy, and will play a significant role in future energy management. One of the fundamental challenge in developing high-performance thermoelectric materials has been to achieve low lattice thermal conductivity (κ_L). The exploration of new materials with intrinsically low κ_L along with a microscopic understanding of the underlying correlations among bonding, lattice dynamics and phonon transport is fundamentally important towards designing promising thermoelectric materials. The origin of lattice anharmonicity and the ensuing ultralow κ_L in the I-V-VI_2 chalcogenides such as $AgSbSe_2$, $AgBiSe_2$, $AgBiS_2$ and AgBiSeS has been traced to the electrostatic repulsion between the stereochemically active ns^2 lone pair of group V cation and the valence *p*-orbital of group VI anion.[1] InTe [i.e. $In^+In^{3+}Te_2$], a mixed valent compound, exhibit an ultralow κ_L, which manifests an intrinsic bonding asymmetry with coexistent covalent and ionic substructures.[2] The phonon dispersion of InTe exhibits, in addition to low-energy flat branches, weak instabilities associated with the rattling vibrations of In^+ atoms along the columnar ionic substructure. These weakly unstable phonons originate from the $5s^2$ lone pairs of adjacent In^+ atoms and are strongly anharmonic, which scatter the heat-carrying acoustic phonons through phonon-phonon interactions. AgCuS exhibits ultra low ºL and it composed of softly coupled cationic and anionic substructures, and undergoes a transition to a superionic phase with changes in the substructure of mobile ions with temperatures.3 Electronic density of states and phonon dispersion reveal that the rigid sulphur sublattice is primarily responsible for the electronic charge transport, whereas soft vibrations and mobility of Ag/Cu ions are responsible for the ultra-low thermal conductivity. Formation of layered intergrowth nanostructures in solid matrix by kinetic matrix encapsulation can also lead to ultralow κ_L.

References

1. Guin, S. N.; Chatterjee, A.; Negi, D. S.; Datta, R. and Biswas, K. ***Energy Environ. Sci.*** 2013, *6*, 2603.
2. Jana, M. K.; Pal, K.; Waghmare, U. V. and Biswas, K. ***Angew. Chem Int. Ed***, 2016, 55, 7792.
3. Guin, S. N.; Pan, J.; Bhowmik, A.; Sanyal, D.; Waghmare, U. V. and Biswas, K. ***J. Am. Chem. Soc.***, 2014, *136*, 12712.
4. Banik, A.; Vishal, B.; Perumal, S.; Datta, R. and Biswas, K. ***Energy Environ. Sci.*** 2016, *9*, 2011.

❖❖❖

IT 9

Recent Developments in Ultrasonic Sensors for U-health Care: Nano-cancer Technology

V.R.Singh

Fellow-USI, Fellow-IEEE, F-ASI, Formerly, National Physical Laboratory, New Delhi, India

Presently, Advisor, PDM University, Bahadurgarh, NCR-Delhi, India

Chair, IEEE IMS/EMBS, Delhi

(Email: vrsingh@ieee.org)

With the advancement of technology, newer and newer sensors are being developed, day by day, for various scientific and health care applications. Nano-ultrasonic sensors, are described here for biomedical and health care applications, particularly, in remote areas, for the benefit of old age patients.

Design and development aspects of macro- to nano- ultrasonic sensors are presented for better healthcare applications. Recent developments in piezo-electric ceramic type, piezo-composite based and biochip-based sensors are presented for diagnostic and therapeutic applications, in a novel way. Ultrasonic characterisation of normal and diseased tissues is used as an index of detecting particular diseases or abnormalities. Cancer nanotechnology is discussed for its use in both diagnostic and therapeutic applications .Deep seated brain tumours are treated with focussed intense ultrasound.

Wireless sensor networking (WSN) technology is applied for ubiquitous health care in different environments in a ubiquitous manner, viz., any where, for any one any time.

These u-sensors would provide an effective and reliable system /tool for better health care, at low cost.

❖❖❖

An Embedded CW Doppler Ultrasonography System: Cloud to add Color

Swapna Banerjee

Department of Electronics and EC Engineering, IIT, Kharagpur
(Email : swapna@ece.iitkgp.ernet.in)

Caring for, helping others are driven by deep value based motivations and concerns to make a positive and practical difference to the lives of other people. Caring for old people or patients was traditionally the responsibilities of the families. But, it depends on whether family members have the time resource.

The availability of high end medical diagnostic systems in primary health care units catering specially to rural areas is low due to the high cost, complexity, and maintenance of the systems. Keeping in mind the rural population, an attempt has been made to design a standalone, portable, low cost Ultrasound Doppler System for integrated imaging and telemedicine applications. The ultrasound system is a non- invasive, non radioactive and inexpensive imaging system.

A Cloud based system receiving ultrasound signal from an embedded Doppler Ultrasound machine has been developed at CAD Laboratory, IIT Kharagpur. The system acquires the Doppler signal through a transducer, calculates its spectrogram, and displays it on a LCD module. The data can also be sent to the cloud for computing the feature values and estimate the vascular abnormalities, and also to an expert over a mobile network.

When an ultrasound signal is transmitted through the blood vessels, due to the blood flow, a Doppler shift occurs in the backscattered signal. It has been observed that these frequency shifts lie in the audio frequency range. By measuring the amount of frequency shift, a hemodynamic assessment of blood vessels can be done.

The CW Doppler Ultrasound System consists of three major blocks, namely, Analog Front End (AFE), Signal Processing Block (SPB), and User Interface Block (UIB). The AFE comprises of the transducer and the associated circuitry

for extracting the Doppler shifted signal and for digitization of the signal. The SPB receives the digitized signal and computes its spectrogram. The block also controls the overall functioning of the system. The UIB takes the spectrogram output from the SPB and displays it on a LCD. It also allows for the spectrogram to be transferred to a Bluetooth enabled mobile device. An automated diagnosis can be done by a Knowledge Base using this spectrogram data in cloud.

Cloud computing is expected to support internet scale critical applications which could be essential to the healthcare sector. Understanding the features of cloud computing viz. scalability, resilience, adaptability, connectivity cost reduction and high performance, an attempt has been made here to measure deep and superficial vascular abnormalities.

❖❖❖

IT 11

Echotexture of liver

Ashok Maulik

Dr. Lal Path Labs
(Email : drashokmaulik@gmail.com)

Sonography is often the first imaging procedure performed in the evaluation of individuals with suspected liver disease. Evaluation for biliary dilatation is always performed, because bile duct obstruction can cause abnormal liver test results, raising the suspicion of liver disease.

Ultrasound is a useful but imperfect tool in evaluating diffuse liver disease. We discuss the uses and limitations of sonography in evaluating parenchymal liver disease. Sonography can show hepatomegaly, fatty infiltration of the liver, and cirrhosis, all with good but imperfect sensitivity and specificity. Sonography is of limited usefulness in acute hepatitis. Increased parenchymal echogenicity is a reliable criterion for diagnosing fatty liver. Cirrhosis can be diagnosed in the correct clinical setting when the following are present: a nodular liver surface, decreased right lobe–caudate lobe ratio, and indirect evidence of portal hypertension (collateral vessels and splenomegaly). Ultrasound plays an important role in the imaging of conditions and procedures common in patients with diffuse liver disease.

Sonographic detection and evaluation of diffuse liver disease may be difficult, because diffuse liver disease does not always cause distortion of the liver parenchymal texture, internal liver architecture, or shape of the liver. This is especially true in patients with acute hepatitis. Liver surface nodularity, parenchymal nodularity, or atrophy of the right lobe, when present, can be useful signs of cirrhosis. Parenchymal echogenicity may be increased in diffuse disease, especially fatty infiltration, but may be difficult to evaluate, because no absolute echo amplitude standard exists; in sonography, there is nothing like the Hounsfield numbers (attenuation numbers) used in computed tomography (CT). Liver echogenicity is judged by comparison with adjacent organs, most often the kidney and is more subjective than objective.

Ultrasound is the first and most important imaging method in suspected liver disease – which holds true both in the sense of proving (e.g., metastatic

disease) and excluding pathology. It is the single best tool in the evaluation of focal liver lesions, unbeaten by any other imaging modality, due to realtime, dynamic nature, high resolution and good safety record. It is invaluable in the differential diagnosis of jaundice, in describing liver cirrhosis complications.

Ultrasound of the liver is the first and most important imaging method in suspected liver disease, is the first indication in evaluation of elevated liver functions tests and cholestasis indicating enzymes. Contrast enhanced ultrasound is helpful especially for focal lesion like tumour detection and lesion characterisation; it can prevent unnecessary further imaging.

Liver sonography is essential for guidance of hepatobiliary interventions such as aspiration, FNABC or core biopsy. Sonography is the most important and handy imaging method in oncological follow up. The use of sonography is limited in the exact measurement of the size of the liver (which is of limited value in the clinical routine); the diagnosis of early cirrhotic stages and in the differential diagnosis of diffuse parenchymal diseases. In summary ultrasound is an indispensable tool in clinical hepatology.

❖❖❖

IT 12

Sonomammography and Grey Areas

Anup K Sadhu

EKO CT and MRI Scan Centre, Medical College,
88, College St Kolkata - 700073
(Email : sadhujee1@gmail.com)

Diagnosis of breast cancer depends on the stage and size of the mass at the time of presentation.A clinician picks up the lesion when it is palpably large.Certain non-cancerous lesions of breast palpable by hand may cause diagnostic confusion.Till date the gold standard of investigating any breast lump is x-ray mammography.

Screening mammography to susceptible patients and after acertain age is widely debated. Confirmation of presence of a breast mass is essentially done by mammography which is highly sensitive x-ray examination of breast

The use of ionizing radiation has led many workers to probe into the effectiveness of sonography in detection of breast cancer.

Ultrasonographyplays three major roles

1) Primary screening
2) Secondary screening –this is usually done in targeted fashion to prevent Biopsies.
3) Follow up mammography of benign lesions, to guide interventions, to find malignancieswhich are missed by mammography e.g in dense breast.

Ultrasonography is widely available, cheaper and with the various sonographic technologies currentlyavailablee.g.Elastography, FTI (fatty tissue imaging),it became an excellent modality in lieu of X-ray mammography in South Asian regional countries.Various studies from this part of the country provided data in favour of sonomammography. However, if "ground-truth" validation is inaccurate, the machine learning tool will be defective leading to wrong BIRAD categorization.

CAD (Computer aided diagnosis) is an useful adjunct to sonomammography

and helps minimizing interobserver variation. The primary tool for detection and diagnosis of breast cancer is x-ray mammography, but currently it is hoped that additional information provided by Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) will provide a means to determine if a suspected lesion, seen in mammography, is malignant or not. The procedure may prevent a large number of retrospectively unnecessary breast biopsies, a surgical procedure, which can result in pain, bruising, and scarring, that is presently used to evaluate suspected breast lesions.

If Computed Tomography (CT) data is available and co-registered with the PET image, such as from a PET/CT scanner, an additional refinement process can be performed. A large number of corresponding surface points can be identified in the MRI and CT images.

References:

[1] American Cancer Society, "Cancer Facts and Figures 2007," available at http://www.cancer.org/downloads/STT/CAFF2007PWSecured.pdf, accessed 19 September 2007.

[2] Krol, A., Unlu, M. Z., Baum, K. G., Mandel, J. A., Lee, W., Coman, I. L., Lipson, E. D., Feiglin, D. H., "MRI/PET Nonrigid Breast-Image Registration Using Skin Fiducial Markers," PhysicaMedica European Journal of Medical Physics, Vol. XXI, Supplement 1, pp. 31-35, 2006.

[3] Krol, A., Unlu, M. Z., Magri, A., Lipson, E., Coman, I. L., Mandel, J. A., Baum, K. G., Feiglin, D. H., "Iterative Finite Element Deformable Model For NonrigidCoregistration of Multimodal Breast Images," Biomedical Imaging: Macro to Nano, IEEE International Symposium, pp. 852-855, 2006.

[4] Krol, A., Coman, I. L., Mandel, J. A., Baum, K. G., Luo, M., Feiglin, D. H., Lipson, E. D., Beaumont, J., "Inter-Modality Non-Rigid Breast Image Registration Using Finite-Element Method," Nuclear Science Symposium Conference Record, IEEE, Vol. 3, pp. 1958-1961, 2003.

[5] Baum, K. G., "Multimodal Breast Imaging: Registration, Visualization, and Image Synthesis," PhD Dissertation, Rochester Institute of Technology, Chester F. Carlson Center for Imaging Science, 2008.

❖❖❖

Cardiac Ultrasound – the basics

D. Banerjee

Consultant physician and Cardiologist, AMRI Hospital, SALT LAKE 106
(Email : debas_banerji@yahoo.com)

Cardiac ultrasound, also known as echocardiography, began its journey way back in 1954 – when Edler and Hertz of Sweden showed mitral valve motion of heart with the primitive makeshift apparatus. Echo cardiography involves ultrasound imaging of a very fast moving complex deep seated organ of our body, the heart. Ultrasound typically involves sound waves in the frequency level of e" 20,000Hz or more.

Peizoelectric crystals (contained in the transducers) convert electrical energy into mechanical sound waves and vice versa- these are harnessed to create images of heart and its varied structures. Harmonic imaging again improves signal to noise ratio and better delineates endocardial borders of the heart.

Analysis of the images are however, highly technology driven – as resolving the diseases of the heart require a detailed representation of that which moves – muscle, valve, blood flow across normal or diseased valves. These require various specialized modes (as detailed below) with their application – as invented by sonologists and physicists. Analyzing the image particulars with corroboration of anatomy and heart – are done by medical doctors. Thus it provides a good physicists – physicians interface.

1. M – mode Echocardiography: depicts the structure along the path of single line of ultrasound beam. It is an icepeak view of the heart – where structures along the line of us beam are plotted against time (x axis).
2. 2-D Echo: here the cardiac structure in the plane verified by transducer position are depicted in two dimension over the screen. The screen is updated continuously – thus producing a sort of movie. Transducer and its marker have been likened to a blade – the placement, rotation and tilt of which will slice the heart as per wish of the echocardiographer and will produce the desired images.

3. Doppler study: as enlightened by Hans Christian Doppler (Austria) – Doppler study/effect is the change in frequency of a wave received by an observer (the reflected frequency) relative to the source of wave (originating frequency). By positive and negative Doppler shifts/ the velocity and turbulence across valves are observed and noted. CFM (color flow mapping) intensifies valvular regurgitation and makes minutest defect visible. Pressure gradient – derived from blood flow velocity as per Bournelli's equation – gives rough idea of pressure difference and chamber pressure.

Thus Doppler technique made echocardiography not only an imaging but also a hemodynamic technique.

For global LV systolic and diastolic function – Tissue Doppler, supplanted by Doppler data are available.

For Analysis of Regional contractility, IHD, assessment by myocardial strain plus strain rate pattern imaging are available.

Now a days, to supplement TTE,(TransThoracic Echocardiography,) Trans-Esophageal technique is developed to image more or more about the less and least 3-D echocardiography recently has hit the market and provide 3-D cone shaped view of area of interest. Both 3D ECHO and3D TEE echocardiographyare now adays used in Lab cathlab and operating rooms even

Thus in short Echocardiography or cardiac ultrasound is a versatile diagnostic modality to provide structural, functional and hemodynamic information about heart – that too in a non- invasive way.

"All the beauty of life is made of light and shadow, when your mind and heart is pure, joy follows like a shadow that never leaves". (Leo Tolstoy)

❖❖❖

IT 14

Advanced Applications of Echo-Doppler Studies in the diagnosis of Heart disease

Bhabani Prasad Chattopadhyay

Associate Professor,Department of Cardiology, Medical College and Hospital,Kolkata, West Bengal,India

(E-mail: bhabani07@yahoo.co.in)

The effective journey of application of ultrasound in cardiovascular medicine was first highlighted in 1960 in the 3rd European Congress of Cardiology in Rome through detection of mitral stenosis, left atrial tumours, aortic stenosis and pericardial effusion. Imaging by M mode,2D examination of heart in motion was followed by addition of conventional Doppler, colour Doppler, tissue Doppler, speckle tracking imaging, contrast echocardiography, trans-esophageal echo(TEE)-doppler study, 3D transthoracic echo(TTE) and TEE reconstruction study and ultimately 3D real time echocardiography .The recent advances of 3D imaging and Speckle tracking had added value to the pre-existing diagnostic capacity of revealing anatomical, haemodynamic and functional status of the heart. Speckle tracking in parasternal short axis views help finding radial and circumferential strain and apical long axis views help eliciting longitudinal strain.The first clinical study using 3D TEE was published from Alabama University at Birmingham in 2007 and now it is popular in percutaneous interventions in Cathlabs and cardiac surgery operation theatres.

❖❖❖

IT 15

Sonographic Interventions: Walk in-walk out Procedure

T. Sarkar

Apollo Gleneagles Hospitals
(Email : tandra.dr@gmail.com)

Overview what is interventional Radiology(IR).Sub branch of Radiology using imaging to perform invasive procedures-Fluoroscopy,CT,US,MRI modalities.Equivalant to pin hole surgery.

Advantages of minimal access-often under LA,short recovery time,able to do procedures in sicker patients.

Prerequisites before interventions.

Brief history of IR.

IR today-vascular,non vascular,interventional oncology,neuro intervention,masculo skeletal intervention and many others.

Non vascular IR:Biopsies,Drains/aspirations,Nephrostomy,PTC and billiary drainage,Gastrostomy feeding procedure.

Overview of different catheters,biopsy needles,guns.

Breast interventions.

Future prospect of IR.

❖❖❖

IT 16

Ophthalmic USG

Arnab Biswas

Consultant Ophthalmologist, Alo Eye Care, Kolkata
(Email: arnabbiswas26@gmail.com)

The principles of ocular ultrasound are the same as it's other applications of this technologyin other parts of the body. The eye is mostly a fluid filled structure. Visualisation of different structures is quite clear, classical and distinctive. So any pathological lesion in the ocular tissue can be clearly detected with the Ultrasonography probe.

There are two main ultrasonic uses in ophthalmology. One is the surgical use, for performing cataract surgery. The second is the diagnostic ultrasound, for detection of any structural abnormality of the eye.

Surgical ultrasound: In modern day cataract surgery, the eye's internal lens is emulsified with an ultrasonic hand piece and aspirated from the eye. This procedure is called Phacoemulsification. Charles Kelman invented the technique of phacoemulsification in the late 1960s. His aim was to remove the cataract with a smaller incision, less pain, and shorter recovery time. He discovered that the cataract could be broken up, or emulsified, into small pieces using an ultrasound tip. At first, Phacoemulsification was slow to catch on because of its long and high learning curve. As the success rate was higher and it required a shorter recovery period, surgeons slowly learned the technique. Over the past decades, surgeons have constantly refined themselves to Phacoemulsification, thus

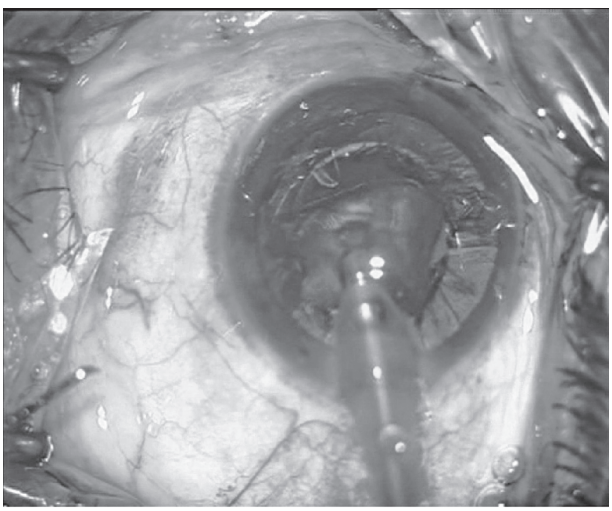


FIG 1: Phacoemulsification in progress to remove cataract

making it safer and more successful. Innovations and development in technology such as the foldable IOL have also helped improve outcomes .

Diagnostic ultrasound: Two main types of diagnostic ultrasound are used in ophthalmologic practice. **A-Scan and B-scan**. In A-scan, or time-amplitude scan, sound waves are generated at 8 MHz and converted into spikes that correspond with tissue interface zones. It is used in obtaining the axial length of the eye ball. This helps in calculation of the intraocular lens power during cataract surgery.

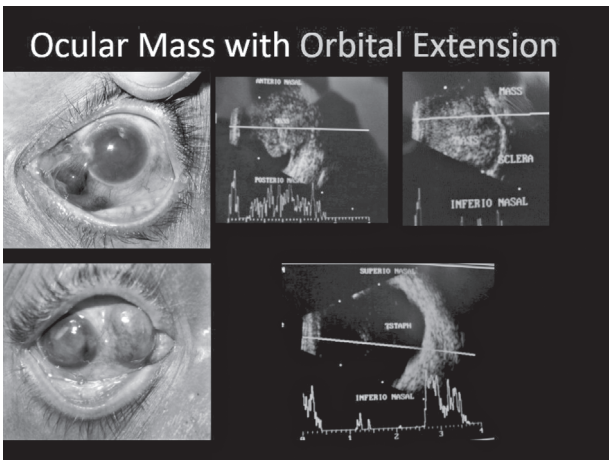


FIG 2: Diagnostic ultrasound scan

In B-scan, or brightness amplitude scan, sound waves are generated at 10 MHz. The information collected by the transducer produces a corresponding image. This is used in clinical diagnosis of any intraocular lesions like tumour, retinal detachment or congenital anomaly. It can provide additional information which is not always readily obtainable by direct visualization of ocular tissues. It is indicated in patients with pathology that prevents or obscures ophthalmoscopy, e.g. large corneal opacities, dense cataracts, or vitreous haemorrhage. Ultrasound images can be obtained through the patient's eyelids or with the probe directly on the surface of the eye with appropriate topical anesthesia.

Referrence:

1. Harrie, R.P. 2011. The ongoing role of ophthalmic ultrasound. *Review of ophthalmology online*
2. Jaffe, Norman S., Mark S. Jaffe, and Gary F. Jaffe. *Cataract Surgery and Its Complications, 6th Edition*. St. Louis: Mosby, 1997.
3. Spaeth, George L., ed. *Ophthalmic Surgery Principles and Practice*. Philadelphia, PA: W.B. Saunders Company, 1982.

❖❖❖

A New Horizon for Dewaxing of Crude Oil: An Ultrasonic Approach

Rita Paikaray

Department of Physics, Ravenshaw University, Cuttack, Odisha, India
(Email: r_paikaray@rediffmail.com)

Energy plays an important role in the economic growth and development around the world. As the conventional oil resources, like petroleum and natural gas are the main sources of energy, the recovery, transportation and storage in oil reservoir are the vital issues in oil industry. The storage of crude oil in reservoir and its transportation is basically affected due to composition of crude oil like paraffins/wax, naphthenics, resins asphaltenes. Various types of methods are used to remove thess compositions or reduce the same. As in most of the cases the economy and cost of separating these impurities are the challenging problems for the oil companies and industries, it needs to be done with more scientific and economy way. Ultrasonic irradiation has proved to be effective for removing adsorbed materials from solid particles, separating solid/liquid in high-concentration suspensions, and decreasing the stability of Wax/Oil emulsion. When ultrasonic wave propagates in the treatment medium, micro bubbles grow to an unstable dimension, they collapse violently and generate shock waves, resulting in very high temperature and pressure in a few microseconds. This can increase the temperature of the emulsion system and decrease its viscosity, increase the mass transfer of liquid phase, and thus leads to destabilization of wax and oil emulsion. Ultrasonic cavitations with a frequency of 120 kHz and 60 W in an ultrasonic tank strip oil constituents from the surface of wax particles and an overall oil separation rate up to 80% from crude oil depending on different chemical blended solution after 30 min of ultrasonic treatment.

Key Wards: Crude oil, Ultrasonic treatment, Paraffin Wax

❖❖❖

IT 18

Microstructural Characterisation in Structural Materials and Residual Stress Evaluation in Weld Joints using Ultrasonics

P. Palanichamy

Retired Senior Scientist, Nondestructive Evaluation Division
Indira Gandhi Centre for Atomic Research, Kalpakkam – 603 102, INDIA
(Email: ppc9854@gmail.com)

Apart from the development in ultrasonic nondestructive testing (NDT) of components and structures, significant progress has been made on the nondestructive evaluation (NDE) of microstructures and material properties using specialized ultrasonic techniques. Further advancement in NDE of microstructures in recent years is the use of signal analysis techniques suitable for online characterization of microstructural feature in structural materials in industries. Residual stress measurements especially in welded components of the structural materials in core industries play key role to avoid premature failure of the components/structures. In this paper, some of the important developmental works carried out on characterisation of microstructures in a variety of structural materials such as carbon steel, AISI type 316 austenitic stainless steels, modified alloy D9, and Zircaloy-2 are presented. Ultrasonics based residual stress measurements techniques developed over the past few decades by using the critically refracted longitudinal waves (Lcr waves) in typical welded structures has also been discussed in this work.

Keywords: Ultrasonics, attenuation, velocity, structural materials, microstructural characterisation, welding, residual stresses, Lcr waves.

❖❖❖

IT 19

Ultrasonic Behaviour of Condensed Materials At Different Physical Conditions

Devraj Singh

Department of Applied Physics, Amity School of Engineering & Technology, Bijwasan, New Delhi-110061, India

(E-mail: devraj2001@rediffmail.com)

Computational ultrasonic non-destructive testing (CUNDT) is a helpful method that can be applied to a variety of materials for the characterization of their microstructures, the assessment of flaws and the determination of physical properties such as density, thermal conductivity and electrical resistivity. Ultrasonic computation taken during the fabrication and heat treatment of materials can be used to ensure that the preferred microstructure is obtained and to prevent the development of fault, including defects in welds between two dissimilar materials. Insight into the interaction of ultrasound with microstructure is also important for resolving numerous material problems. Ultrasonic attenuation and backscattering reduce the detectability of defects in condensed materials with coarse grains or complex microstructures. Therefore, it is desirable to minimize attenuation in order to maximize the usefulness of ultrasonic testing. Information about the microstructure can also be used in material description studies, such as nondestructive calculation of grain size. Wave propagation velocity is another key parameter in ultrasonic characterization and can provide information about crystallographic texture. The ultrasonic velocity is directly related to the elastic constants and density of the material. The elastic constants, in particular, provide valuable information on the stability and stiffness of materials [1, 2, 3]. The establishment theoretical perception and relevance of condensed materials is a part of discussion. Theoretical analysis of the observed behaviour of elastic, thermal and ultrasonic properties in these materials will be made to establish the characteristic features realizing the fact that dissipative loss is prominent over the scattering loss in the condensed materials. Ultrasonic absorption and velocity in the condensed materials were evaluated at different physical conditions. In addition, theoretical pressure derivatives of second order elastic constants, Breazeale's non-linear parameters, Debye temperature, thermal conductivity are discussed in present

talk for finding future performance of the condensed materials.In present talk, most of discussion is focused on rare-earth monochalcogenides and monopnictides. The rare-earth monopnictides and monochalcogenides have recently attracted special attention in many applications owingto their interesting physical, electronic, and mechanical properties that make them significantmaterials for technological and many areas of industrial applications particularly in the field ofspintronics [4].

Keywords: Rare-earth monopnictides, higher order elastic constants, ultrasonic velocity, ultrasonic attenuation, pressure derivatives, thermal conductivity.

References:

[1] V. Bhalla, D. Singh and S. K. Jain, 2016, Mechanical and thermophysical properties of cerium monopnictides, *International Journal of Thermophysics* (Springer), Vol. 37 (33), March, pp. 1-17, doi: 10.1007/s10765-016-2038-0

[2] D. Singh, P. K. Yadawa and S. K. Sahu, 2010, Effect of electrical resistivity on ultrasonic attenuation in NpTe, *Cryogenics* (Elsevier), Vol. 50, pp.476-479; doi:10.1016/j.cryogenics.2010.04.005

❖❖❖

IT 20

Acoustic Performance of walls made with sustainable and industrialized dry construction panels

Mahavir Singh

AUV Standards, CSIR-NPL, New Delhi, India
(Email : mahavir.singh@gmail.com)

The aim of this paper is the evaluation of the acoustic performance of a dry construction system including effects of mainly mass and stiffness in single layer and method of adding gypsum board or framing arrangement, sound absorbing material, cavity thickness and mass in double or triple layer walls. Different kind of materials and dry construction systems, which are focused in the reduction of wastes, like the dry system, are increasing in the Market. The development of materials and dry construction systems which integrate residues in its composition is a growing tendency in the Indian building sector. There are, nowadays, sustainable and industrialized panels for sealing walls, such as Oriented Strand Boards (OSB), Cement-Concrete Block (CCB), Fiber reinforced cement boards and gypsum plasterboard. These panels have found their place in the sealing walls market because of their better performance and lower costs, when compared to conventional sealing materials, such as concrete or ceramic masonries. This paper shows the acoustic performance of a dry construction system, which is built with Steel framing and the different kinds of panels described above. The measurements were performed according to ASTM 413. Results show that the acoustic performance of the dry construction system, measured according to ASTM 413 parameters, is better than those from traditional walls built with concrete or ceramic masonries, in regard to sound insulation.

Keywords: Acoustic performance, Sustainable wall panels, Acoustic measurements

❖❖❖

IT 21

Some Recent Developments in Force Monitoring/ Actuation using Piezo-electrics and Ultrasonics

S.K. Jain

The NorthCap University, Gurgaon 122017
Formerly Chief Scientist, NPL, New Delhi
(Email : skjain@ncuindia.edu)

Piezoelectrics and ultrasonics have had a symbiotic growth. Piezoelectricity was discovered in 1880s and soon its application came in the form of underwater echo-sounding which was deployed in I world war for detection of submarines. Real boost to the technology came in 1950s with the invention of lead zirconate titanate piezoelectric ceramics. Today applications of piezoelectrics and ultrasonics together with microprocessor based electronics have become almost an indispensable tool in medical diagnostics, material testing, sonar, certain engineering processing, etc. Besides this there are numerous applications where piezoelectric/ ultrasonic sensing is used. Force sensing, actuation and monitoring are inherent requirements in a large number of applications in industry, robotics, surgery and research. Different techniques based on different principles, such as piezo-resistive, capacitive, and piezoelectric sensors are being used to measure force depending up on their suitability for particular applications. Piezoelectric technique offers many alternatives for sensing based on parameters such as resonant frequency, impedance/ frequency bandwidth, voltage / charge generation, etc. and for actuation based on parameters such as piezoelectric strain coefficient, radiation force (ultrasonic tweezers), cavitation, shock-wave, etc. The present paper attempts to highlight in brief some of the basic principles involved in force sensing/ actuation, their salient features and applications. Some investigations carried out on a resonant force transducer and a piezo-amplifier actuator would be discussed.

❖❖❖

ORAL PRESENTATION

OP 1

Computation of Erosion Potential of Cavitation Bubble in an Ultrasonic Pressure Field

B.K Sreedhar[1*], S.K. Albert[2] and A.B Pandit[3]

[1] *Corresponding author, Fast Reactor Technology Group (FRTG), Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, India*

[2] *Materials Technology Division, Metallurgy and Materials Group, IGCAR, Kalpakkam, India*

[3] *Department of Chemical Engineering, Institute of Chemical Technology (ICT), Mumbai, India*

(Email of corresponding author : bksd@igcar.gov.in)*

Cavitation is the creation and collapse of a vapor cavity in a liquid. When the collapse occurs adjacent to a solid boundary it results in material removal / damage. Cavitation can be produced in a liquid in the presence of a sound field and this principle is employed in an ultrasonic vibratory cavitation device. In this apparatus, which is used in the laboratory to study the effects of cavitation, a horn immersed in the liquid and vibrating at 20 kHz imposes on the liquid a sinusoidally varying pressure field of the same frequency. The rapidly fluctuating applied pressure results in cavitation of the liquid. This devise is commonly used to study the effects of cavitation, notably erosion damage, in the laboratory.

The study of the dynamics of vapor bubbles in the presence of an ultrasonic field is useful to obtain theoretical estimates of velocity at the end of collapse and the resulting pressure generated from the impingement of the jet on the solid boundary. The pressure produced by the collapse of a vapor bubble can be determined by solving equations of bubble dynamics. The fundamental equation of bubble dynamics is the Rayleigh-Plesset-Noltingk-Neppiras-Poritsky equation popularly known as the RP equation. This equation does not account for the effect of liquid compressibility which, however, is important in the final stages of collapse of a cavitation bubble. Using the Kirkwood-Bethe hypothesis, Gilmore formulated an equation that accounts for liquid compressibility. Gilmore's equation can be used to obtain realistic estimates of bubble wall velocities at the end of bubble collapse.

This paper discusses the numerical solution of Gilmore's equation to evaluate the bubble wall velocity at the end of bubble collapse and the pressure imposed on a solid surface from jet impingement. The parameters affecting the growth and collapse of a single bubble is studied and the calculations are done for bubble collapse in water as well as in liquid sodium which is the heat transfer medium in a fast reactor. A discussion of results of cavitation damage experiments in sodium is also provided as a confirmation of the theoretical estimate of damage.

❖❖❖

OP 2

Ultrasonic Attenuation at High Temperatures in Palladium metal

K. K. Pandey

Department of Physics, School of Basic Sciences and Research, Sharda University, Greater Noida, India

(E-mail: kkpandey35@gmail.com)

Ultrasonic attenuation due to p-p interaction and thermoelastic loss has been evaluated in Xth group rare transition metal Pd in a wide temperature range (100K to 1500K) for longitudinal and shear waves along <100>, <110> & <111> directions and for shear waves polarised along different directions. Electrostatic and Born–Mayer potentials have been used to obtain SOEC & TOEC (i.e. the second order elastic constants and third order elastic constants), taking nearest–neighbour distance and hardness parameter as input data. SOEC & TOEC data obtained at different temperatures have been used to obtain Gruneisen parameters and non-linearity or anisotropy parameters which in turn have been used to evaluate the ultrasonic attenuation coefficients, $\left(\frac{\alpha}{f^2}\right)_1$ & $\left(\frac{\alpha}{f^2}\right)_s$ in Akhiezer regime. Results have been discussed and it has been found that at lower temperatures $\left(\frac{\alpha}{f^2}\right)_1$ increases rapidly with temperature and then rate of increase becomes very small. Contribution to the total attenuation due to thermoelastic loss is negligible that due to p-p interaction establishing that major part of energy from sound wave is removed due to interaction with thermal phonons (lattice vibrations).

Keywords: Ultrasonic attenuation, p-p interaction, thermoelastic loss, Gruneisen parameters.

❖❖❖

OP 3

Development of two dimensional sensor arrays for Underwater Acoustic Imaging

G. Suresh, A. Shanavas, V. Natarajan

Naval Physical and Oceanographic Laboratory, Thrikkakara, Kochi 682021

(Email: natarajan@npol.drdo.in)

High resolution acoustic imaging systems are used to identify geometrical features of underwater objects, rather than its location. These systems operate at higher frequencies and hence possess shorter imaging ranges. Two challenges limit the feasibility of 3D acoustic imaging using 2D arrays: Achieving high acoustic power, Source level, during transmits and high sensitivity during receive using a small array element, and interconnecting dedicated transmit and receive processing circuitry for each element. The main challenges in the use of 2D arrays resides in the element number reduction, the grating lobes suppression, the increase of the array resolution making the main lobe narrower and increase of the element size to maximize the array sensitivity to improve its signal to noise ratio. Three types of 2D sensor arrays were designed and developed using 1-3 piezo composites - 5x5 sensor array operating at 250 kHz and 6x6 sensor array operating at 400 kHz and 12x12 array operating at 500 kHz. The 2D transducer array operating at 500 kHz have 128 square shaped elements, avoiding the 2x2 corner elements. The array consists of 1-3 piezocomposite active elements, matching layer, backing block, acoustic absorber, insulating cover, sensor electrodes and transducer housing. The element dimension is based on the pitch corresponding to the design frequency. Special FRP fixtures were designed and fabricated to make electrical contact with each element in the array. Matching layers on the front face and suitable acoustic backing on the rear side of the transducer are incorporated by using moulds. The array is protected with pressure release along the sides from mechanical noise/impacts and also suitable EMI shielding provided. An external casing is developed for holding the fully encapsulated transducer array to work as a transducer probe holder. The transducer active elements have an acoustic backing and covered with a waterproofing layer. A layer of polyurethene over the front face of the element provides

waterproofing and acoustic matching to control and enhance the bandwidth of the transducer. This leads to a higher efficiency and improved output levels and enhanced receiving sensitivity. The sensor arrays were electrically characterised and evaluated for their performance. The inter element cross talk among the sensor elements for the 400 kHz array is -30 to -41 dB. The transmittance (SL) and receiving characteristics (RS) has been measured using pulse echo method in an acoustic tank with linear positioning system, for 128 element array are 198.7 dB & -197.4 dB at 500 kHz. An experimental investigation of acoustic imaging of objects with different shapes and dimensions were studied. The physical dimensions of 2D array elements and their spatial distribution within the array is found to affect their performance, particularly in the beam pattern produced by the transducers. These 2D arrays find applications for ultrasound volumetric imaging.

Keywords: Acoustic imaging, Two dimensional array, Transducer cross-talk

❖❖❖

OP 4

Toward Remote Shear Wave Inspection

M. Messaoudi and B. Pouet

Bossa Nova Technologies (11922 Jefferson Boulevard, Culver City, CA 90230, USA)
(Email: mmessaoudi@bossanovatech.com, bpouet@bossanovatech.com)

Ultrasonic inspection has mainly been based on the generation and detection of longitudinal waves. Generally, a vertical shear wave is generated with piezoelectric transducer, and then detected through mode conversion. This same method is now commonly used in angle beam inspection. Over the past decades, the use of an electromagnetic acoustic transducer (EMAT) has emerged as the most efficient technique for generating and detecting shear waves. However, successful EMAT applications have been limited to the inspection of conductive materials and at frequencies below 10MHz. Additionally, though non-contact, EMAT inspection cannot be conducted remotely.

Unlike EMAT technology, laser ultrasonic (LU) systems can be operated remotely and provide high-frequency capability, potentially providing an effective solution for nondestructive inspection. To date, however, most LU receivers have been limited to the detection of the out-of-plane surface displacement. With the aim of providing a versatile LU inspection system, Bossa Nova Technologies will present a compact LU receiver capable of simultaneously measuring both the out-of-plane and in-plane displacements. Taking advantage of recent developments in electronic processing, we have achieved the development of a compact optical architecture, using a single collecting aperture and a single laser probe beam. Accompanying remote in-plan detection, an improved method of LU generation producing normal-incidence shear waves will also be presented. The combination of shear-wave LU generation with a multi-component laser receiver makes LU pulse-echo shear-wave inspection possible.

Experimental results are presented, demonstrating the capability of laser generated shear wave propagating normal to the sample surface. The measured P-wave and S-wave directivity are displayed, with results correlating with predictions. Characterization of the compact interferometer for simultaneous in-plane and out-of-plane measurement is also described.

Keywords: in-plane, shear waves, three dimensional

OP 5

Application of Ultrasonic Testing Technique as a Condition Monitoring Tool in Steel Industry

Shunmugasundaram Rajendran[1*], Balamurugan Sriniwasagan[1], and Shivanandan S Indimath[1] and Monojit Dutta[1]

[1]Research and Development, Tata Steel Ltd., Jamshedpur, India.
*(*E-mail of corresponding author: rs.sundaram@tatasteel.com)*

Integrated steel industry ranges from mines to final products such as wires, rebars, wire rods and hot and cold rolled sheets. Its manufacturing process involves various stages, where critical equipments are involved in. Condition monitoring of critical components helps in averting unexpected failures, which will result in safety and monetary benefit. In this work application of ultrasonic testing as a condition monitoring tool for three critical components have been discussed; compound rolls used in hot and cold rolling mills, copper tuyeres and seal valve axles in blast furnaces. Critical parameters which have to be monitored for ensuring the integrity of those components also have been identified and the detailed inspection procedure has been discussed in the paper. The paper also discusses the importance of quantitative inspection over qualitative inspection. Critical components in each steel industry are unique; hence it is difficult to come out with common acceptance criteria. In this regards, quantitative inspection procedure enables us to customize the acceptance criteria according to given circumstances.

Keywords: Ultrasonic testing, Compound rolls inspection and Quality assurance of Copper Tuyeres.

❖❖❖

OP 6

Study of Localized Deformation Using Nonlinear Ultrasonic Technique by Lamb Wave Mixing

Avijit Kr. Metya[*,a], Soumitra Tarafder[a] and Krishnan Balasubramaniam[b]

[a] *MST Division, CSIR- NML, Jamshedpur- 831007*

[b] *CNDE, Mechanical Engineering Department, IIT Madras, Chennai- 600036*

*(*E-mail: avijit@nmlindia.org; avijit353@gmail.com)*

Nonlinear ultrasonic technique has been proven to be very sensitive to localized deformation. This technique relies on the generation of harmonic components when a purely sinusoidal wave is transmitted through the degraded material in which the relation between stress and strain is no more linear but nonlinear in nature that involves higher order elastic constants. The initial pure sinusoidal wave is distorted due to the presence of nonlinearity within the materials and generates higher order harmonics. But the extraction of the material nonlinearity is difficult using this technique as it involves nonlinearities generated from the instrumentations as well as external environment. Therefore, Lamb wave mixing technique has been used to assess the localized deformation in which two Lamb wave modes of different frequencies are allowed to mix within the material to generate third type of harmonic waves of frequencies ($\omega_1 \pm \omega_2$). The generated mixing wave carries the information of the material nonlinearities from the mixing zone. Finite element simulation shows the potentiality of using this mixing technique as a tool for material characterization.

❖❖❖

OP 7

Application of Second Harmonic Based Ultrasonic Signal Analysis for Evaluation of Micro Structural Changes due to Creep Damage in Ni- based Super alloy

Minati Kumari Sahu[1*], J.Swaminathan[1], N.R. Bandhoypadhyay[2] and S.Palit Sagar[1]

[1]*-CSIR-National Metallurgical Laboratory, Jamshedpur, India-831007*

[2]*-IIEST, Shibpur, West Bengal, India-711103*

[*]*(E-mail address: minati.sahu@gmail.com)*

Super alloys are used primarily in aerospace, super heaters and evaporator tubes which require a material with high mechanical strength, good resistance to fatigue and creep, good corrosion resistance and ability to operate continuously at elevated temperatures. Operating under conditions, i.e. high temperature and/or high stress, these materials have potential failure locations and limiting life due to creep for the entire plant. In addition, once a failure occurs, it reduces life and operating time of high temperature components. Most common practice of creep damage detection is replica metallography. This technique can provide quantitative data on the defects, and voids of 1 mm or less. But an obvious limitation of this technique is that it cannot detect subsurface defects. Moreover this technique requires careful surface preparation and is a lengthy procedure that can normally be applied only at maintenance intervals and that is prone to subjective interpretations. Hence there is an obvious need to develop alternative or complementary non-destructive evaluation (NDE) technique which can detect early stage of creep. Acoustic waves have been widely used as a NDE tool in the field of detection of materials integrity. However most of the conventional ultrasonic NDE methods are sensitive to gross defects, but not much sensitive to evenly distributed micro-cracks, whereas, harmonic analysis of ultrasound was found to be more effective for micro structural damage evaluation. The aim of this research is to develop an experimental procedure to reliably measure the acoustic nonlinearity by second harmonic generation of ultrasonic wave, known as non-linear ultrasonic (NLU), due to materials damage in terms of precipitations,

voids and micro cracks especially during creep. Inconnel 600 having is being investigated in this research because it is one of the most widely used standard engineering materials with good strength and workability. Constant load creep tests were conducted on a standard creep machine at temperature 730°C and stress levels of 67 MPa till the failure. Experiments were carried out in two different ways; i) interruptions made on a single sample till rupture to correlate the NLU parameter with the strain rate and ii) on different samples where each sample interrupted at different creep exposure time to establish a correlation with micro structural variations. Results showed that NLU parameter is able to distinguish clearly the three different regions of creep and also can predict the remaining life of the material.

Keywords: Creep; non linear ultrasonic, Inconnel 600, Microstructure, Strain rate

❖❖❖

OP 8

Ultrasonic Characterization of Adenine in Aqueous Solution by Non-Destructive Technique

P. D. Bageshwar[1], N. R. Pawar[2] O. P. Chimankar[3], and R.D.Chavhan[3]

[1]*Department of Physics, Mungsaji Maharaj Mahavidyalaya, Darwha – 445 202, India*

[2]*Department of Physics, Arts, Commerce and Science College, Maregaon – 445 303, India*

[3]*Department of Physics, RTM Nagpur University, Nagpur- 440 033, India*

Corresponding Authors : pawarsir1@gmail.com, opchimankar28@gmail.com

Ultrasonic characterization of Adenine in aqueous solution by non-destructive technique is essentials for utilizing them in biomedical technology. In biological sciences, nitrogenous bases are increasingly termed nucleobases because of their role in nucleic acids, their flat shape is particularly important when considering their roles as the building blocks of DNA and RNA. The ultrasonic technique is widely used as a non-destructive method as it does not change the properties or structure of the materials. The ultrasonic velocity, viscosity, and density measurements for aqueous solution of nitrogenous bases particularly Adenine at different molar concentrations and temperature at fixed frequency 4MHz have been calculated and discussed graphically. All the plots of ultrasonic velocity (u), viscosity (ç), density (ñ) etc indicate intermolecular interactions between the components of mixtures. The obtained results have been interpreted, in the light of intermolecular interactions in terms of making and breaking tendency of solute and solvent in the solution. The non-linear and complex behaviour of adenine in aqueous medium helps to detect phase separation and strength of intermolecular interactions between the constituents in the aqueous solution of adenine. These studies may be

very important in the medical fields particularly in the study of DNA and RNA as well as in the industries.

Key words: Non-destructive technique; nucleobases; adenine; molar concentrations.

❖❖❖

OP 9

Interaction Study of Paracetamol with Anti-arthritis Drugs in Protic Solvent Media- an Ultrasonic Study

Monalisa Das[1], Smrutiprava Das*[2], Suchitra Mohanty[3], Sunil Kumar Pradhan[4], Ashok Kumar Sahoo[5] and Ajaya Kumar Patnaik[6]

[1]*Department of Chemistry, Govt. Women's college, Keonjhar, Odisha*
[2,4,5,6]*PG Department of Chemistry, Ravenshaw University, Cuttack*
[3]*Department of Chemistry, Stewart Science College, Cuttack*
(Email :** dr.monalisachem@gmail.com, **dassmrutiprava@yahoo.in)

The measurement of density, ultrasonic velocity and their related parameters give basic information regarding different type of interactions. The physico-chemical properties can be easily studied using these parameters. Anti-arthritis drugs such as ibuprofen and diclofenac are chosen for the study which possesses different medicinal activities. Diclofenac is used to treat pain and swelling caused by arthritis but to a limit the amount. Ibuprofen is a non-steroidal anti-inflammatory drug (NSAID) which blocks the inflammation process in the body to relieve from swelling and pain. Paracetamol (acetaminophen) acts as a pain reliever and a fever reducer which is also used to treat many conditions such as headache, muscle aches, arthritis, backache, toothaches, colds, and fevers. It relieves pain in mild arthritis but has no effect on the underlying inflammation and swelling of the joint. So this paper aims at the effect of paracetamol when taken along with ibuprofen or diclofenac. Here the effect of paracetamol on ibuprofen and diclofenac in methanol medium are studied through ultrasonic study. The ultrasonic parameters include adiabatic compressibility(β), inter molecular free length(L_f), acoustic impedance(Z), Relative association (R_A), apparent molar compressibility (K_ϕ), limiting apparent molar compressibility (K_ϕ^0) and the associated constant (S_K) . The data of ultrasonic velocity and related parameters indicate the presence of interaction between ibuprofen and diclofenac in methanol medium. The data also indicate that interaction of ibuprofen-methanol mixture get enhanced due to the formation of hydrogen bonding between paracetamol and ibuprofen. But paracetamol interact less strongly with diclofenac confirmed from the measured

data. So steric effect may arise which reduces the strength of interaction of paracetamol with diclofenac-methanol system. So it can be concluded that paracetamol interact more strongly with ibuprofen than diclofenac in methanol medium. The strength of interaction is related to the nature of interactions.

Key words – Ultrasonic velocity, adiabatic compressibility, acoustic impedance, ibuprofen, diclofenac.

❖❖❖

OP 10

Molecular Interaction of Non-steroid Anti-Inflammatory Drug Aceclophenac with Leucine in DMSO Medium: an Ultrasonic Study

S. K. Pradhan[1], S. P. Das[2*], A. K. Sahoo[3], M. Das[2] and A. K. Patnaik[2]

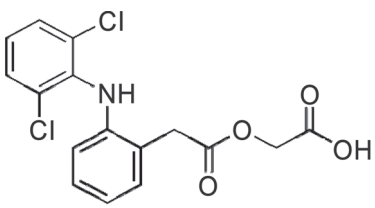
[1]Department of Chemistry, Brahmani College,Dandisahi,Kendrapara, Odisha -754240 , India

[2]Department of Chemistry, Ravenshaw University, Cuttack, Odisha-753003, India*

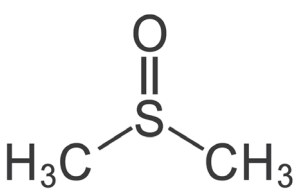
[3]Department of Chemistry, Christ College, Cuttack, Odisha-753008, India

*(*Corresponding author E-mail: dassmrutiprava@yahoo.in)*

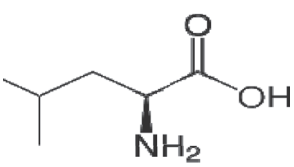
Non steroidal anti-inflammatory drug aceclophenac has hydrophobic and hydrophilic domain. It is sparingly soluble in water and miscible in blood due to hydrophilic nature. It exhibits analgesic, antipyretic and anti-inflammatory activities. It is also used in rheumatoid arthritis. It is inhibitor of clotting in the blood vessel, thus prevents heart attack and stroke. Leucine is an essential α- amino acid used in biosynthesis of protein and also used for muscle building. It contains α- amino group, carboxylic acid group and an isobutyl side chain. Ultrasonic study of aceclophenac with leucine in DMSO medium provides much useful information about the nature of molecular interaction. In our body drug interaction with protein play very vital role in the biological process. Because of the 3D structure of protein, it is quite difficult to study its interaction with drugs in the biological system. As amino acid is a model component for protein, in this piece of work we have studied the drug amino acid molecular interaction with variation of concentration of



Aceclophenac



DMSO



Leucine

amino acid ranging from 0.002-0.01 mol/kg and the drug concentration varies from 0.0002-0.001 mol/kg. The different acoustic parameters like adiabatic compressibility (β), intermolecular free length (L_f), acoustic impedance(z),apparent molar volume(V_φ),apparent molar compressibility (K_φ),partial molar volume (V_φ^o),partial molar compressibility (K_φ^o), John Dole coefficient A,B are calculated from density (ρ), ultrasonic velocities (U) and viscosity (Q″) data. The parameters are calculated at 298.15K in a polar aprotic medium i.e. taking DMSO as solvent and were interpreted in terms of ion-solvent, ion-ion and ion-dipole interactions considering the structure breaking and structure making aspects of the solvent.

Keywords: anti-inflammatory drugs, adiabatic compressibility, apparent molar volume, John Dole coefficient, Leucine, ultrasound

❖❖❖

OP 11

Ultrasound as a Tool to Measure Articulatory Dynamics and Direction of Coarticulation

Irfana, M[1] and Sreedevi, N[2]

[1]*Junior Research Fellow, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Manasagangothri, Mysore -570006*

[2]*Reader in Speech Sciences, Department of Clinical Services, All India Institute of Speech and Hearing, Manasagangothri, Mysore -570006*

(Email of corresponding author: fanairfana@gmail.com)

Tongue is an active articulator in speech production system. Measuring tongue movements during speech is difficult because the tongue is positioned deep within the oral cavity and inaccessible to most instruments. Ultrasound is one of the non invasive tools to measure the tongue dynamics both in midsagittal and coronal view. Present study aimed to analyze articulatory dynamics and coarticulatory pattern across stop consonants, within and across language families. adult speakers including equal number of native speakers of Kannada and Malayalam under Dravidian languages and Hindi, an Indo Aryan language participated as subjects. The stimuli consisted V1CV2 sequences with C corresponding to voiced/ unvoiced counterparts of dental (/t*/, /d*/) or retroflex (/ˆ/, /V/) or velar stops (/k/, /g/), in the context of vowels /a, i, u/. Tongue contours and the distance between tongue contours of each vowel and consonant (V1 to C and V2 to C) were obtained using Mindray 6600 Ultrasound module and was calculated using Articulated Assistance Advanced (AAA) based on Root Mean Square (RMS) method. Findings showed evident deviation of articulatory posture of following vowels towards the consonants and it was marked for retroflexes in all the three languages. Results of RMS distance comparison showed that there was a clear pattern of anticipatory coarticulation in Dravidian languages, however, there were different patterns such as carryover coarticulation and balanced coarticulation along with anticipatory coarticulation in Hindi. This study emphasizes the use of ultrasound as a tool to measure spatial and temporal dynamics of tongue and coarticulatory pattern. Also, these findings help to understand the speech production system across languages. Further, ultrasound can be considered as a feedback tool during speech and language intervention for individuals with communication disorders.

Keywords: Ultrasound, Coarticulation, Malayalam, Kannada, Hindi.

OP 12

Recent Progress in Multi-detector LASER Ultrasonic Receiver for Industrial Measurements

M. Messaoudi and B.Pouet

Bossa Nova Technologies (11922 Jefferson Boulevard, Culver City, CA 90230, USA)

(Email: mmessaoudi@bossanovatech.com, bpouet@bossanovatech.com)

Laser-based ultrasonics (LBU) are a maturing technology, experiencing the transition from laboratory-research equipment, to industrial on-line measurement systems. The non-contact, remote capability of LBUs are an undeniable advantage for high-speed inspection. As LBUs compete with other inspection technologies for on-line integration, they must retain their performance advantages despite, operating in far from ideal environments.

In 2004, Bossa Nova Technologies introduced a new type of LBU receiver. The new system was based on multi-channel random-quadrature (MCRQ) detection, and addressed the specific requirements associated with LBU inspection in industrial environments. Utilizing this new technology, we demonstrated that it is possible to transform a high-sensitivity but delicate laboratory interferometer, into a rugged system capable of enduring the challenges posed by industrial environments.

The MCRQ design is inherently robust. Rejection of unwanted environmental perturbations is achieved electronically, and no critical alignment is necessary. The system can be set-up directly at the measurement site, or can be placed away from the sample for remote measurement via a fiber link connected to a small optical head. Using an arrangement of Si photodetectors or GaAs photodetectors, the QUARTET can operate at any optical wavelength, from visible to infrared, where single-frequency lasers are available.

In this presentation we will describe the principle of operation as well as review recent developments in the MCRQ receiver. Finally, we will present various examples of measurements, including the inspection of Carbon Fiber Reinforced Polymer (CFRP) and thickness measurement on a moving sample using zero group velocity Lamb wave resonance.

Keywords: high-speed inspection, multi-channel random-quadrature

OP 13

Elastography, Speckle Reduction, Harmonic Imaging—Enhancing Image Quality and Extracting Additional Features for Improved Medical Diagnosis

Subhranil Koley

School of Medical Science and Technology (SMST)
IIT, Kharagpur
(Email : iman.ec.87@gmail.com)

The introduction of ultrasound elastography has given a breakthrough in breast cancer diagnosis. It enables the early stage diagnosis of malignancy and also reduces the use of conventional procedure of invasive biopsy for confirmatory diagnosis. Essentially, the quantitative evaluation of breast lesion with respect to strain ratio index improves the diagnostic accuracy. We will discuss the insight of this imaging technique for breast lesion analysis.

Currently elastography has also extended its use in hepatic fibrosis and prostatic neoplasm

We will discuss speckle reduction techniques from US images for improving the image quality leading to enhanced visualization of clinical imaging features.

Tissue Harmonic imaging (THI) also improves image quality and quantifies tissue pathologies in unique way'

The essence is to avoid the needle either fine or the Tru-cut ones

All these issues will be considered in the talk in brief

❖❖❖

OP 14

Acoustical-assisted Synthesis and Characterization of Graphene nano sheets

Rintu Varghese*, Joy Prabu. H and Johnson. I.

Centre for Nano science and Applied Thermodynamics, Department of Physics, St. Joseph's College, Trichy – 620002, Tamilnadu, India.

*(*Corresponding author: rintuvarghese1@gmail.com)*

Graphene (rGO) is a highly functional material for the energy sector. To get single-layer of graphene, exfoliating fully intercalated graphite oxide into single layer graphene oxide (GO) is one of the important factors. In this paper, facile ultrasonication route for the synthesis of rGO nanosheets via reduction of GO has been reported. The ultrasonication approach for the synthesis of rGO nanosheets is relatively fast, cost-effective and efficient as compared to other methods. The rGO Graphene nanoparticles were characterized by the XRD, FTIR, UV, and TEM. The sizes of particles were calculated using scherrer formula from XRD pattern. FT-IR analysis further confirmed the preparation of GO and rGO. The UV–Vis spectroscopy results showed that the absorption peak was red shifted due to the reduction of GO into rGO. The morphology and structure of the particles were described by TEM. Due to these outstanding material's characteristics, graphene is one of the most promising materials and stands in the focus of energy application research.

Key words: Graphene, ultrasonication, rGO, XRD

❖❖❖

OP 15

The Effects of Ultrasound: Bandgap Tailoring of ZnO

Anupam Nandi, Hiranmay Saha and Sanhita Majumdar*

*Centre of Excellence for Green Energy and Sensor Systems (CEGESS), Indian Institute of Engineering Science and Technology (IIEST), P.O. Botanic Garden, Shibpur, 711103, Howrah, West Bengal, India. (*Email : email2sm@gmail.com)*

Zinc oxide (ZnO), with a direct band gap of 3.37 eV and large exciton binding energy of 60 meV, is a fundamentally important material that has attracted great interest because of a combination of semiconducting, piezoelectric, and pyroelectric properties and at the same time it can exhibit the most splendid and abundant configuration of nanostructure that one material can form. It is well known that the novel properties of nanomaterials are obviously dependent on size, shape as well as crystallinity, crystallite size, crystallographic orientation and morphology. Therefore, morphologically controllable synthesis of ZnO nanomaterials is of utmost importance to satisfy the demand for exploring their potential applications in optical, microelectronic, chemical and biological fields especially for use in solar cells, sensors, biosensors, ultraviolet nano-lasers, light emitting devices (like, LEDs), actuators, energy storage and in areas of biomedical sciences.

In this study, ZnO nanocrystals with different shape, size and morphology have been synthesized by room temperature wet chemical method by the help of sonochemical technique starting from four different zinc compounds viz., acetate, chloride, nitrate and sulphate as precursors. Currently, sonochemistry has emerged as a cheap, simple and alternative route of nanopowder preparation. The chemical effects of ultrasound arise from acoustic cavitation, which is the formation, growth and implosive collapse of bubbles in a liquid [1]. The cavitation can generate a temperature of around 5000OC and a pressure over 1800 kPa, which enable many unusual chemical reactions to occur easily [2]. Ultrasonic energy has introduced into the system to control the sizes of the nanoparticles and to incorporate defect states in the lattice orientations which proved beneficial for its applications. Attempts have been made to tune the band gap and/or band energy of the synthesized ZnO nanoparticles. Influence of sizes and shapes of the nanoparticles and their

defect- responsive phenomena have been investigated by systematic XRD, FTIR and FESEM studies. Corresponding band structures and band energies have been investigated by PL spectra and UV-viz. analysis. This kind of band tuning properties by shifting exciton binding energy of ZnO with the help of ultrasonication can be useful in the field of gas sensors, solar cell as well as in other applied arenas.

Keywords: ZnO nanocrystals; Room temperature synthesis; Sonochemistry; Tunable band gap.

References

[1] K.S. Suslik, Ultrosound: Its Chemical, Physical and Biological Effects, VCH Publisher, Weinheim, 1998.

[2] S. Majumdar, P. S. Devi, Synthesis of SnO2 Nanoparticles Using Ultrasonication, AIP Conf. Proceed., vol. 1276, 2010, pp. 1-7.

❖❖❖

OP 16

On-line Ultrasonic Characterisation of Ni_2MnSn Heusler Alloys

K. Sakthipandi[1]*, M. Sivabharathy[1], E.Ahilandeswari[1] and A. Senthil Kumar[2]

[1]*Department of Physics, Sethu Institute of Technology, Kariapatti 626 115, Tamil Nadu, India*

[2]*Department of Mechanical Engineering, Sethu Institute of Technology, Kariapatti 626 115, Tamil Nadu, India*

*(*E-mail of corresponding author: sakthipandi@gmail.com)*

In recent years, Heusler alloys have become a centre of scientific investigations, both theoretically and experimentally, because of their interesting physical properties. These alloys were interesting because some of them were ferromagnetic even though their constituent atoms were non-ferromagnetic in elemental form. Ultrasonic velocity and attenuation measurement is a versatile tool to explore the mechanical properties as well as the phase transition in the solids. Magnetic refrigeration technology is of particular interest because of its less energy consumption and environmental friendly as compared to gas compression refrigeration. In this study, an investigation was made on the substitution of excess Ni atoms in Ni_2MnSn Heusler alloys. Heusler alloys such as Ni_2MnSn, $Ni_{2.05}Mn_{0.95}Sn$, and $Ni_{2.10}Mn_{0.90}Sn$ were prepared by arc melting using the appropriate amounts of the constituent pure elements. To confirm the crystalline nature of the sample, neutron diffraction spectra were obtained. These alloys have $L2_1$crystal structure even at high temperature. On-line ultrasonic velocity and attenuation measurements were carried out in the range of temperature from 300 to 500 K. The observed anomalous behaviour in the ultrasonic parameters was used to explore the paramagnetic to ferromagnetic transition at temperature of the prepared sample. The Curie temperature (T_C) for is found to be 349, 337 and 317 K. Further, the T_C was turned towards the room temperature with increasing the concentration of Nickel.

Keywords: Heusler Alloys, Ultrasonic velocity, Attenuation, Transition Temperature

❖❖❖

OP 17

Design and Analysis of Ultrasonic Horn for Cavitation Generation in Liquid Sodium

B.K Sreedhar[1], Nilayendra Chakraborty[2], S.K Albert[3] and A.B Pandit[4]

[1] corrresponding author, Fast Reactor Technology Group (FRTG), Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, India. (Email : bksd@igcar.gov.in)

[2] Fast Reactor Technology Group (FRTG), Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, India.

[3] Materials Technology Division, Metallurgy and Materials Group, IGCAR, Kalpakkam, India

[4] Department of Chemical Engineering, Institute of Chemical Technology (ICT), Mumbai, India

A vibratory cavitation device is commonly used in the laboratory to study cavitation erosion damage of materials in liquids. These devices are designed and operated in conformance with ASTM-G32 code. The main component of this device is the horn which is used to generate cavitation in the test liquid. The horn operates at ultrasonic frequency and is powered by a piezoelectric crystal driven by an ultrasonic generator.

This paper discusses the analysis and design of an ultrasonic horn operating at 20 kHz with peak to peak displacement amplitude of 50 microns at the free end. The free end of the horn is immersed in liquid sodium. The material selection and design of the horn is carried out for a maximum temperature of 550æ%C. The horn is also provided with features to facilitate sealing of the vessel containing the test liquid (sodium) while ensuring that the necessary amplitude is obtained at the free end without unduly stressing the horn.

The analysis is carried out using FEM software and the results are compared with the measured values.

Keywords : Cavitation, vibratory device, sodium, ultrasonic horn, design

❖❖❖

OP 18

Elastic and Ultrasonic Properties of Hexagonal Intermetallic Ternary Compound

Pramod Kumar Yadawa[1]* and Raja Ram Yadav[2]

[1]*Department of Applied Physics, AMITY School of Engineering and Technology, Bijwasan, New Delhi-110 061, India*

[2]*Department of Physics, University of Allahabad, Allahabad-211002, India*

*(*E-mail: pkyadawa@rediffmail.com)*

The elastic, acoustic and mechanical properties of the hexagonal intermetallic NdCuGe ternary compound have been studied along unique axis. The second and third order elastic constants have been calculated for NdCuGe compound using Lennard–Jones potential model. The temperature variation of the ultrasonic velocities is evaluated along different angles with unique axis of the crystal using the second order elastic constants. The ultrasonic velocity decreases with the temperature along particular orientation with the unique axis of crystals. Temperature variation of the thermal relaxation time and Debye average velocities is also calculated along the same orientation. The temperature dependency of the acoustic properties is discussed in correlation with elastic, thermal and electrical properties. It has been found that the thermal conductivity is the main contributor to the behaviour of ultrasonic attenuation as a function of temperature and the responsible cause of attenuation is phonon-phonon interaction. The mechanical properties of NdCuGe compound at low temperature are better than at room temperature, because at low temperature it has low ultrasonic velocity and ultrasonic attenuation. This compound has received strong attention in recent years because of their important role in many technological applications such as microwave devices, permanent magnets, magnetic and optical recording devices.

Keywords: Elastic properties; Thermal conductivity; Acoustic properties; Ternary intermetallic compounds.

❖❖❖

OP 19

Study of Thermodynamic Properties in Binary Liquid Mixtures Through Ultrasonic Measurement

Mathana Gopal. A[*] and Poongodi. J.

Department of Physics, Kamaraj College, Thoothukudi-628003, Tamilnadu (Email: poongodinagaraj@gmail.com)

To understand the intermolecular interactions in organic liquids and liquid mixtures, the study of ultrasonic and thermodynamic parameters are of due importance. Ultrasonic velocity, density & viscosity have been measured experimentally in the two binary mixtures of ethanol & isopropyl alcohol with benzene at different temperatures over the entire composition range. The thermodynamic and other allied parameters like free volume, internal pressure, enthalpy etc., have been computed and the variation of the excess parameters like excess free volume, excess internal pressure, excess enthalpy, etc., are analyzed in the light of intermolecular interactions in the mixtures. The variation of these parameters as a function of solvent composition has been discussed from the view point of intermolecular interactions present between the unlike molecules. In both the mixtures, intermolecular interactions between the constituent molecules are suggested.

Keywords: Ultrasonic velocity, free volume, internal pressure, enthalpy, excess values, molecular interactions.

❖❖❖

OP 20

Acoustic Transducer using Indigenously Developed (Tb,Dy)Fe_2 rods

J. Arout Chelvane, Himalay Basumatary, Mithun Palit and S. Pandian

Defence Metallurgical Research Laboratory,
Hyderabad – 500 058, India
(Email : mithunpalit@gmail.com)

Magnetostrictive materials exhibit dimensional changes due to the presence of magnetic field. When such a material is exposed to an applied alternating magnetic field, the resultant effect is felt in the generation of acoustic waves. These materials are, therefore considered for constructing acoustic transducers.

As is well known, magnetostriction is an inherent property of the material and is time invariant. Exchange of energy between electrical / magnetic and mechanical (acoustic) is thus a possibility with these materials, giving an excellent scope for detection of underwater objects. For such transduction function, the magnetostictive materials are required to exhibit high energy density, high force, broad frequency bandwidth and fast response. For long and until the end of World War II, nickel was widely used in SONAR. However, as Ni offers low strain level (~ 36 micro -strains) and a low magneto-mechanical coupling co-efficient (k_{33} ~ 0.30), acoustic transducers generating low frequency waves (as to minimize attenuation) and its usage in SONARs (as to maximize the surveillance range) remained a distant dream. The intensive search for newer materials resulted in discovering giant magnetostrictive (Tb,Dy)Fe_2 that provides a much higher strain values (as high as 1500 micro-strains as against 36 micro-strains realized from Ni) and superior coupling co-efficient (k_{33} ~ 0.9). These exotic characteristics are realizable only when this material is produced under directional solidification condition, imparting grain orientation along the easy axis of magnetization. Fabrication of a transducer capable of generating high intensity - low frequency acoustic waves has been, thus made possible and it holds a great promise for better performance than that derived from transducers based on piezoelectric materials.

While the new rare earth based magnetostrictive material offers wide scope for constructing a high power, low frequency acoustic transducer, such a technical accomplishment hinges on (i) material processing to achieve requisite properties and (ii) design and fabrication of the transducer device to demonstrate the required performance. Material processing itself involves issues such as achieving sharp grain orientation along the direction of easy magnetic axis, the microstructure devoid of secondary phases that affect the property development etc. The design and fabrication of the transducer device, on the other hand, involves issues related to applying the required bias field to the active elements with the aid of a solenoid, imposing on it, additionally a drive field through a drive coil, closure of magnetic flux lines, assembling all the components and evaluating finally the acoustic performance. In this talk, we intend to share the experience we gained (i) in the successful development of the (Tb,Dy)Fe_2 magnetostricvie material at DMRL, adopting the modified Bridgman technique for directional solidification, and (ii) in the usage of these materials as active elements to fabricate a tonpilz transducer which has been done in collaboration with NPOL, a system laboratory of DRDO .

❖❖❖

POSTER SESSION

Ultrasonic Wave Propagation in Ternary Intermetallic CeCuGe Compound

Aashit Kumar Jaiswal[1,a], Pramod Kumar Yadawa[2,b] and Raja Ram Yadav[1]

[1]*Department of Physics, University of Allahabad, Allahabad-211002, India*

[2]*Department of Applied Physics, AMITY School of Engineering and Technology, New Delhi-110 061, India*

(E-mail: [a] ajaiswal386@gmail.com, [b] pkyadawa@rediffmail.com)

The elastic and ultrasonic properties of the hexagonal intermetallic CeCuGe ternary compound have been evaluated along unique axis at room temperature. Higher order elastic constants have been calculated for CeCuGe compound using Lennard–Jones potential model. The ultrasonic velocity, Debye average velocity, thermal relaxation time and acoustic coupling constant are evaluated along unique axis of the crystal and the temperature variation of the ultrasonic velocities is evaluated along different angles with unique axis of the crystal using the second order elastic constants.

Keywords: Elastic properties; Ultrasonic velocity; Ultrasonic attenuation.

❖❖❖

PS-I 2

Ultrasonic Attenuation in Trimetallic Nanofluid

Navneet Yadav*, Aashit K. Jaiswal and R. R. Yadav

Department of Physics, University of Allahabad, Allahabad, 211002, India
*(*E-mail: navaneetyadav840@gmail.com)*

Novel metals have numerous applications in the field of science and technology due to their electrical, chemical and optical properties. At nano level, these properties of metal enhances as compare to its bulk material. In the present work, the trimetallic Au/Pt/Ag nanoparticles have been synthesized using microwave irradiation and reducing the ions with reducing agent. The synthesized trimetallic nanoparticles have been characterized by UV-Vis spectroscopy for the absorption study. UV-Vis spectroscopy confirms the formation of trimetallic nanoparticles. Transmission electron microscopy has been done for the morphological study. Ultrasonic attenuation in the nanofluid has been, then, measured by acoustic particle sizer over wide frequency range. These attenuation data has been used to measure the particle size and their distribution in the nanofluid. Results of particle size distribution by APS were found in good correlation with transmission electron microscopy.

Keywords: Nanoparticles, ultrasonic attenuation. Acoustic attenuation.

❖❖❖

Ultrasonic Study on Nuclear Extractant for Micro Extraction of Uranium Nitrate

R.Giri* and G. Nath

Department of Physics, Veer Surendra Sai University of Technology, Sambalpur -768018, Odisha

*(*Email: physics.leena@gmail.com, ganesh_nath99@yahoo.co.in)*

The presence of third phase in mixing of extractants-diluent pair with aqueous phase of Rare Earth Elements (RRE) imposes the problems in extraction of Rare Earth Elements (RRE). The appropriate solvent mixture in proper concentration is an important step in the solvent extraction process. In the present work, the extraction of uranium with the binary mixture of Methyl Ethyl Ketone (MEK) and Kerosene was investigated. Diluent like kerosene was added to the solvent mixture for the removal of the third phase which appears during the extraction process, which is the main obstacle in the solvent extraction technique. It is necessary to examine the different molecular interaction present in the binary mixture and to obtain the compatible blend for increase the extraction efficiency by removing the third phase. These intermolecular interactions present in the liquid mixture were studied by evaluating different acoustical parameters using ultrasonic technique. Using the measure value of ultrasonic velocity, density and viscosity of the liquid mixture these acoustical parameters were calculated. Based on the solvent extraction process, the optimal solvent mixture composition with the highest possibilities of uranium extraction was obtained for an optimum composition range of MEK. This optimal composition range of the binary mixture gives good result for the extraction of uranium determined using Nernst distribution coefficient.

Keywords: Rare earth element, acoustic parameter, ultrasonic velocity, organo-aqueous phase, intermolecular interaction

❖❖❖

PS-I 4

Comparative Study of Binary Mixture of Natural Sap of Phoenix Sylvestris "PS" and Adansonia Digitata (AnD) at Room Temperature

Chouhan R.S.[1], Chouhan M.S.[2], Phadke S[3].Shrivastav B.D.[4], Mishra A.[5]

[1]*Dept.of Physics Yash College Badnawar, MP, INDIA*
[2]*Dept.of Chemistry Shri Ambika College Badnawar, MP, INDIA*
[3]*Dept.of Physics Govt. Girls College Dhar, MP, INDIA*
[4]*Dept.of Physics Govt. P.G. College Bioara, MP, INDIA*
[5]*School of Studies in Physics, DAVV, Indore, MP, INDIA*
(Email : sushilphadke5@gmail.com)

The ultrasonic velocity measurement helps to understand the molecular interactions of solid and liquid in different solvents. The main aim of the present study was to compare thermo acoustical parameters of aqueous and ethanolic binary liquid mixtures of Adansonia Digitata fruit powder (AnD powder) and Phoenix Sylvestris sap (PS sap). The ultrasonic velocity (USV) and, density and some acoustic parameters such as acoustic impedance (Z), Isentropic compressibility (β_a) and intermolecular free length(L_f) is calculated and compared at fixed frequency 2MHz and at constant temperature 308K.. Result shows almost similar variations in thermo acoustical parameters with solid and liquid solute in same solvent and same concentrations.

Keywords: Ultrasonic velocity, binary mixture, Phoenix Sylvestris sap, Adansonia Digitata,

❖❖❖

PS-I 5

Study of Acoustical Parameters of Dextran in 2(M) Glycine Using Ultrasonic Technique at Different Frequencies

***Subhraraj Panda[1] and Achyuta Prasad Mahapatra[2]**

[1]Research scholar, PG Department of Physics, Ravenshaw University, Cuttack, Odisha, India.

[2] ELISA, Cuttack, Odisha, India.

*(*E-Mail: subhraraj4u@gmail.com)*

The propagation of ultrasonic waves and the measurement of their velocity in solutions form an important tool for the evaluation of various acoustical and thermo dynamical parameters which shown to be useful in understanding the solute-solvent interaction and packing effects of solutes with solvent molecules. The thermo-physical parameters density (ρ), ultrasonic velocity (U) and viscosity (η) have been measured for Polymer dextran in 2(M) glycine at 308K, at four different frequency i.e, 1MHz, 5MHz, 9MHz and 12 MHz at different concentration of dextran. Using the experimental values of density (ρ), viscosity (η) and ultrasonic velocity (U) some of the acoustical parameters like free volume (V_f),internal pressure (Π_i),absorption coefficient or attenuation coefficient (α), Rao's constant (R) and Wada's constant (W) have been calculated keeping temperature constant at 308K. The variation of these parameters with respect to concentration and frequency has been discussed in the light of solute-solvent and solute-solute interaction.

Key Words: Aqueous dextran, Ultrasonic velocity, Free volume(V_f),Internal pressure (Π_i),Absorption coefficient or attenuation coefficient (α), Rao's constant (R),Wada's constant (W).

PS-I 6

Comparative Study of Molecular Interactions in Ternary Liquid Mixtures by Ultrasonic Techniques

[*]Manoj Kumar Praharaj[1], Abhiram Satapathy[2]

[1,2] Department of Physics, ABIT, CDA, Sector-1, Cuttack, Odisha, India - 753014

*(*E-mail: m_praharaj@rediffmail.com)*

The ultrasonic velocity (U), density (ρ) and viscosity (η) have been measured for the ternary mixture of benzene, toluene and pyridine successively with N, N-dimethylformamide in cyclohexane at different temperatures and at frequency 2 MHz for different concentrations of component liquids. The experimental data of velocity, density and viscosity have been used for a comparative study of the molecular interaction in the different mixtures using different parameters such as adiabatic compressibility, free length, free volume and surface tension. Variation in the above parameters for the different mixtures is indicative of the nature of interaction between them.

Keywords: Ternary mixture, Ultrasonic velocity, Surface tension.

❖❖❖

Ultrasonic and Thermal Properties of DI-Water Suspended Cobalt Ferrite Nanoparticles

Punit K. Dhawan[1*], Meher Wan [2], R.R.Yadav[1]

[1]*Department of Physics, University of Allahabad, Allahabad-211002, India*

[2]*Advanced Technology Development Center, Indian Institute of Technology, Kharagpur- 721302, India*

(Email: punitdhawan@hotmail.com)

In the present investigation, cobalt ferrite nanoparticles have been synthesized via simple chemical route and further suspended in DI water. Ferrites have the crystal structure of AB_2O_4 type and show good ultrasonic and magnetic properties. Using ultrasonic technique we measure the particle size distribution of cobalt ferrite nanoparticles in DI water. The synthesized nanoparticles are characterized by Transmission Electron Microscopy to confirm the morphological properties of the synthesized material previously characterized by ultrasonic technique. A comparison of TEM and Ultrasonic technique was made and found that they are in good correlation. Temperature dependent thermal conductivity of cobalt ferrite nanoparticles has been studied to understand the ultrasonic and thermal behaviour of nanoparticles.

Keywords: Cobalt Ferrite, Thermal Conductivity, Acoustic Particle Sizer.

❖❖❖

PS-I 8

A Comparative Ultrasonic Characterization of $CuFe_2O_3$ + PVA and $ZnFe_2O_3$ + PVA Nanofluids

Shakti Pratap Singh*, Aashit Kumar Jaiswal, R. R. Yadav

Department of Physics, University of Allahabad, Allahabad-211002, India
*(*E-mail: shaktisinghballia@gmail.com)*

The nanofluids of $CuFe_2O_3$and $ZnFe_2O_3$ nanoparticles suspended in base fluid of PVA have been prepared using single step process with the help of ultrasonicator. Uv- Visible Spectroscopy and X-ray diffraction (XRD) were used for the characterization of the synthesized samples. The particle size distribution (PSD) measurement is carried by Acoustic Particle Sizer (APS-100). The ultrasonic velocities are measured in the synthesized nanofluids under different physical conditions using an ultrasonic interferometer. It has been found that ultrasonic velocity has non-linear relation with temperature for the present nanofluids. The PSD measurement shows that there is good agreement between microscopic measurement and ultrasonic attenuation spectroscopy.

Keywords: Acoustic Particle Sizer, PVA, Ultrasonic Velocity.

❖❖❖

Study of Molecular Interaction in Ternary Liquid Mixture of an Aprotic Liquid using Ultrasonic and Viscosity Probes

Ashok Kumar Dash[1], and Rita Paikaray[2]

[1]*Department of Physics,L.N College.Patkura.Kendrapara.Orissa,India*

[2]*Department of Physics, Ravenshaw University Cuttack, Orissa, India*

(E-mail of corresponding author: ashok.phy@ rediffmail.com)

The ultrasonic velocity (U),density (ρ) and coefficient of viscosity(η) of the ternary mixture of dimethyl acetamide, isobutyl methyl ketone and diethyl ether at frequencies $2MH_Z$, 4MHz, $6MH_Z$ and $8MH_Z$ have been measured at temperature 308K. Adiabatic compressibility (K_s), intermolecular free length (L_f), free volume (V_f), internal pressure (π_i) and their respective excess values have been computed for entire range of mole fraction and are interpreted to explain molecular interaction occurring in the liquid mixture. Relaxation time (τ), excess enthalpy (H^E) and absorption coefficient α/f^2) have been calculated and discussed. The negative excess values of coefficient of viscosity η^E indicate the presence dispersion, induction and dipolar forces in ternary liquid mixture.The negative values of excess adiabatic compressibility K_s^E, excess free length L_f^E, excess free volume V_f^E and excess enthalpy H^E and the positive values of excess internal pressure π_i^E indicate the presence of specific interactions in the ternary liquid mixture.

Keywords: Ternary mixture, ultrasonic velocity, free volume, internal pressure, relaxation time, excess enthalpy, and absorption coefficient

❖❖❖

PS-I 10

Acoustical Investigation in Zinc doped Titanium Dioxide Nanofluids

Gaurav Singh*,Shakti Pratap Singh and R. R. Yadav

Department of Physics, University of Allahabad, Allahabad, 211002, India
*(*Email-gphy.93@gmail.com)*

Synthesis of nano sized Zinc doped Titanium Dioxide particles has become an important part of modern research due to their ultrasonic properties. In the present investigation, we have synthesized zinc doped Titanium Dioxide and Its nanofluids using sol-gel method. The particle size distribution of the prepared nanoparticles has been determined using acoustic particle seizer (APS-100). It is based on measurement of ultrasonic attenuation and velocity depending upon the frequency. Ultrasonic velocity measurements in synthesized nanofluids have been made using the ultrasonic Interferometer at different thermal conditions

Keywords: APS, Nanofluid, Ultrasonic velocity.

❖❖❖

Mechanical and Thermo Physical Properties of Lutetium Monochalcogenides

Devraj Singh[1], Amit Kumar[2,] *and Ram Krishna Thakur[2]

[1]*Department of Applied Physics, Amity School of Engineering & Technology, Bijwasan, New Delhi-110061, India*

[2]*Amity School of Applied Sciences, Amity University Haryana, Manesar-122413, India*

*(*Email: amitrana1711@gmail.com)*

We have investigated higher order elastic constants, Young modulus, bulk modulus, Cauchy's relation, Zener anisotropy factor, fracture to toughness ratio, Debye temperature, ultrasonic velocity, ultrasonic Grüneisen parameter for lutetium monochalcogenides (LuX: X = S, Se and Te) in the temperature range 100-300K. Most of these properties are obtained by the application of the second order elastic constants. The Cauchy's relation deviates at high temperatures. The fracture to toughness ratio is less than 1.75, so these materials are brittle in nature. The Born stability criterion has been satisfied by the chosen monochalcogenides. So these materials are mechanically stable. The obtained results are discussed in correlation with mechanical and thermophysical properties of the chosen materials.

Keywords: Lutetium monochalcogenides, elastic properties, ultrasonic properties.

❖❖❖

PS-I 12

Study Molecular Interaction in Binary Liquid Mixtures Containing N-hexane and Triethylamine in Acetonitrile at Temperature 301.15K

J. N. Ramteke, Apurba Ghosh, P.D.Bhagwat and S.A.Wani

S. M. Mohota College of Science, Nagpur-440009 (MS), India.
(E-mail: ramtekejitendra66@gmail.com)

Ultrasonic is an area of intense scientific and technological research. In view of its extensive scientific and engineering applications it attracts attention of researchers, non- destructive testing professionals, industrialists, technologists, medical practitioners, instrumentation engineers, software engineers and medical scientists. The study of ultrasonic waves in pure and liquid mixtures is useful to examine the nature of intermolecular interactions occurred in these liquids. The various acoustic parameters such as ultrasonic velocity, density, viscosity, adiabatic compressibility, free length, acoustic impedance, relaxation time, free volume and internal pressure are useful in understanding molecular structure and molecular interactions in the medium.

Ultrasonic velocity and absorption measurements in binary liquid mixture as a function of the concentration and concentration are useful in gaining insight into the structure and bonding of associated molecular complexes and other molecular processes occurs in these liquid mixtures. The results observed in these ultrasonic measurements have been correlated with molecular interactions in liquid mixtures with some degree of success. The absorption and velocity of sound in binary mixtures of triethylamine with Acetonitrile and clorobenzene with Acetonitrile have been measured at a central frequency of 5MHz, using the interferometer. Ultrasonic absorption peaks at intermediate concentrations have been found in a binary mixture. In this work, measurements of the velocity, absorption coefficient, density, adiabatic compressibility, excess compressibility, and shear viscosity as functions of the concentration are reported. The adiabatic compressibility and excess compressibility were calculated from the velocity and the density measurements. The ultrasonic velocity (u), density (ρ) and viscosity (η) have been measured for the binary

mixtures of triethylamine with Acetonitrile and clorobenzene with Acetonitrile at 305.15K. From the experimental data, Internal Pressure (p_i), Relaxation time (τ), Wada's constant (W) and Enthalpy(H) have been calculated. In addition to that the excess values of certain above parameters are also computed. These excess parameters have been used to discuss the presence of significant molecular interactions in binary mixture. By taking measurements at several concentrations of each liquid mixture, we obtained information about the molecular association between the two different molecules in the liquid mixture.

Keywords: Ultrasonic Velocity, Absorption, Molecular Interactions, Adiabatic Compressibility, Excess Compressibility and Shear Viscosity.

❖❖❖

PS-I 13

Effect of Ultrasonic Wave for Removal of Wax from Crude oil in Presence of Blended Chemicals

A. Tripathy[1, 3], G. Nath[2] and R. Paikaray[3]

[1]*Dept. of Applied Science and Humanities, ABES Engg. College, UP, India*

[2]*Dept. of Physics, Veer Surendra Sai University of Technology, Sambalpur, Odisha, India*

[3]*Department of Physics, Ravenshaw University, Cuttack, Odisha, India*

(Email: tripathyamita21@gmail.com, r_paikaray@rediffmail.com)

The need for energy is becoming more crucial these days and is causing more companies to drill for oil.Wax deposition and control continues to be a challenging problem in the oil and gas industry. The problem is observed in which the ambient temperature is lower than the wax appearance temperature (WAT), the oil cools resulting in wax deposition. Regular pigging and chemical inhibitors can keep the pipeline clean and free of deposition but they are quite expensive and have not shown good results to completely eliminate wax deposition in pipelines. The blends of organic solvents like Methyl Ethyl Ketone (MEK) and bromo benzene are determined by computing acoustical parameters of the organic solvent using experimental values ultrasonic velocity data determined by ultrasonic interferometer and measured values of density and viscosity. The variation of acoustic parameters, their excess values is discussed in terms of molecular interactions present in the solvent mixture, which explains the physio- chemical behaviour in the crude at WAT due to complex formation.The optimum dewaxing of crude oil was determined by the ultrasonicator operating at frequency 120 kHz, 60 W ultrasonic powers, and 30 min at 303 K and subjected to a laboratory centrifuge of rpm 2000 for 30min. The microscopic image of the crude oil verifies agglomeration of wax molecules in treated crude oil.

Keywords: Crude oil, wax appearance temperature, solvent mixture, ultrasonic velocity, acoustic parameter

❖❖❖

PS-I 14

Concentration Dependent Acoustical Properties of Manganese Ferrite Nanoparticles Suspension in Ethylene Glycol

Alok Kumar Verma*, R. R. Yadav

Department of Physics, University of Allahabad, Allahabad, India
(E-mail: alok9369@gmail.com)*

Ferrite nanofluids are smart colloidal suspensions of ferrite particles in base fluids. They have tremendous applications in field of engineering, industry and biomedical etc. In the present study, manganese ferrite is synthesized using sol-gel method. The nanofluids of $MnFe_2O_4$ nanoparticles suspended in base fluid of ethylene glycol have been synthesized using single step process with the help of ultrasonicator. We have determined the particle size distribution of the synthesized nanoparticles by ultrasonic spectroscopic method using acoustic particle sizer (APS-100). APS is based on measurement of ultrasonic attenuation depending upon the frequency. Further, temperature dependent ultrasonic velocities in $MnFe_2O_4$ nanofluids have been determined at different concentration using the ultrasonic interferometer.

Keywords: $MnFe_2O_4$, Sol-Gel, APS, Ultrasonic velocity.

❖❖❖

PS-I 15

Infinite Slope Critical Depth Estimation using Ultrasonics for Pilani Soil

K. Kumar

Department of Civil Engineering, Birla Institute of Technology & Science, Pilani, India

(Email : kamalesh@pilani.bits-pilani.ac.in)

Infinite slopes are slopes of large extent in which soil is in inclined orientation above hard strata or bed rock. Hillside slopes or valley slopes are examples of infinite slopes. From geotechnical construction point of view, information about critical depth in such slopes for slope angle more than angle of internal friction (friction angle) of the soil is an important design consideration. If soil height above hard strata or bed rock is less than critical depth in such infinite slopes, translational slide of slope will not take place. Required geotechnical construction activity can be undertaken accordingly. For no seepage condition, aforementioned angle of internal friction has to be determined at worst in-situ water content and proper drainage condition. For no seepage condition, this critical depth depends on cohesion, angle of internal friction, slope angle and bulk density of soil. Cohesion and angle of internal friction has to be determined at worst in-situ water content and at proper drainage condition. Consequently, complicated experiments in the field as well as in the laboratory have to be carried out. Complicated use of equation is also involved. In present study, calibration curve has been developed to estimate the critical depth using ultrasonics for Pilani soil. For the development of calibration curve, soil from two different location of Pilani has been taken. Sand from one location retained on 150micron sieve and silty clay from other location (retained on 75micron sieve & pan) have been mixed in five different compositions with silty clay varying from 10% to 90%. Ultrasonic pulse velocity through these five samples have been determined at worst in-situ water content and at average in-situ bulk density using through transmission technique. Frequency of ultrasonic pulses used was 150kHz. Soil from any other location in Pilani has only to be sieved through 300micron sieve and pulse velocity has to be determined using through transmission technique at same water content and bulk density. One will be able to read the critical depth directly from the calibration curve

for known pulse velocity. Only for pulse velocity, more than a particular value additional sieving through 150micron sieve will be required. This technique of critical depth estimation is much simpler than conventional approach as pulse velocity through soil is very simple to determine. Technique can be used at other places also.

Keywords: Infinite slope, Critical depth, Cohesion, Friction angle, Pulse velocity.

❖❖❖

PS-I 16

Ultrasonic studies on $BaBr_2$ in dioxane-water at 303.15K

Braja B.Nanda[1*], Subrat Nayak[2] and Susant K. Biswal[2]

[1]*P.G. Department of Chemistry, Vikram Deb Autonomous College, Jeypore-764001, Odisha, India*

[2]*Department of Chemistry, Centurion University, Bhubaneswar, Odisha, India*

(Corresponding author's Email: bbnanda.driems@gmail.com)

Thermo-acoustic parameters are useful to understand the effect of temperature on the interactions of $BaBr_2$ with aqueous solutions of dioxane. Density(ρ), viscosity(η) ultrasonic velocity(u) of $BaBr_2$ in a mixed solvent of dioxane and water (10%,20%,30% & 40%) were measured at T= 303.15 K. Ultrasonic measurements have been made on the solutions of dioxane and water(10%,20%,30% & 40%) at T= 303.15 K. The derived acoustic parameters like isentropic compressibility (K_S), acoustic impedance (Z), molar compressibility (W), molar sound velocity(R), relative association (R_A), intermolecular free length (L_f), free volume (V_f), internal pressure (π_i), ultrasonic attenuation (α/f_2), van der Waals constant (b) have been calculated from the experimental data. Also the nonlinearity parameters (B/A), isothermal compressibility (β_T), co-efficient of thermal expansion (α) and heat capacity ratio (γ) have been calculated. These parameters have been used to discuss the ion-solvent interactions in the solutions.

Keywords: Thermo-acoustical parameters, $BaBr_2$, Dioxane-Water, Ultrasonic velocity.

❖❖❖

Ultrasonic Investigation of Strong Electrolytes (Metal Chlorides) in Aqueous Ethanol Systems at Various Temperatures

Bidyadhar Swain[1]*, Rabindra N. Mishra[2] and Upendra N. Dash[3]

[1]*Department of Physics, DRIEMS, Cuttack, India*

[2]*PG Department of Physics, Ravenshaw University, Cuttack, India*

[3]*Plot No.436, Chakeisihani, Bhubaneswar, India*

*(*Corresponding author's e-mail:* ***bidya.swain11@gmail.com)***

The density (d), ultrasonic velocity (U) and viscosity (ç) measurements have been carried out for strong electrolytes, e.g., magnesium chloride and zinc chloride in 5, 10 and 15 wt% of aqueous ethanol in different concentrations over the temperature range 298.15K to 313.15K at 5K interval. Various thermo-acoustical parameters, such as acoustic impedance (Z), isentropic compressibility (K_s), intermolecular free length (L_f), relaxation time (τ), Gibb's free energy change (ΔG), ultrasonic attenuation (α/f^2) have been computed from the experimental data to investigate the ion-solvent and solvent-solvent interactions in these systems. It is observed that the ion-solvent and solvent-solvent interactions depend on concentration, temperature and nature of the electrolyte. The qualitative intermolecular elastic forces between the solute and solvent molecules are explained in terms of compressibility. The structural arrangement of molecules in electrolyte solutions has been discussed on the basis of electrostatic field of ion.

Keywords: Strong electrolytes, Acoustic impedance, Intermolecular free length, Ultrasonic attenuation.

❖❖❖

PS-I 18

A Comparative Study of Acoustic Parameters in Binary Mixture of di-n -butyl Phthalate (DBP) with non Polar Liquids

N.Mohanty and R.Paikaray

P.G .Deppt of physics, Ravenshaw University, Cuttack-753003 Orissa (E-mail-r_paikaray@rediffmail.com ,mohantyninima@gmail.com)

Ultrasonic study of molecular interactions in a binary mixture of Di-n-butyl phthalate (DBP) with non-polar liquids is carried out at constant temperature and frequency. The experimental measured values of density (ρ) and ultrasonic velocity(C) of the binary mixture are used to calculate the different acoustic parameters like isentropic compressibility (β) intermolecular free length (L_f), acoustic impedance (z) and interaction parameter (a"). Excess value of the above parameters like excess isentropic compressibility (β^E) excess intermolecular free length (L_f^E), excess impedance (Z^E) and).excess ultrasonic velocity (U^E) are also calculated. These acoustic parameters and their excess values are compared and used to access and explain the nature and strength of molecular interaction of DBP with non-polar liquids.

Keywords: Binary mixture, ultrasonic velocity, isentropic compressibility, intermolecular free length, acoustic impedance, interaction parameter

❖❖❖

Rheological, Optical and Ultrasonic Investigation of Poly Ethylene Glycol Methyl ether Methacrylate 300 (PEGMA-300) with 2-methoxyethanol and 2-Ethoxyethanol at Varying Temperatures

Ajaz Hussain, Laxmi Kumari and Mahafuj Ali Ansari

Department of Physics, University of Lucknow, Lucknow 226007, India.

***(*Corresponding author, e-mail:** guptagm@rediffmail.com, hussainajaz4@gmail.com)*

Mixing of Polyethylene glycol methyl ether methacrylate 300 (PEGMA-300) with 2-methaxyethanol and 2-ethoxyethanol can expand the range of structural properties and the scope of molecular interactions between the molecules of solvents. Exploiting of these phenomena essentially require a basic fundamental understanding of mixing behavior PEGMA-300 with molecular solvents. To characterize the thermophysical properties of this mixture, precise measurement of density (ρ), viscosity (η) and ultrasonic velocity (u) over the whole composition range have been performed over wide temperature ranges (193.15K, 203.15K, 313.15K). From these experimental data, deviation in isentropic compressibility ($\Delta\kappa_s$), excess intermolecular free length (L_f^E), deviation in ultrasonic velocity (Δu), excess acoustic impedance (Z^E) and excess Gibb's free energy of activation for viscous flow (ΔG^{*E}) were calculated. The Redlich–Kister polynomial equation was adopted to compute and correlate the results, and a good agreement has been observed between experimental and calculated values. The measured and predicted data were interpreted on the basis of intermolecular interactions and structural effects between like and unlike molecules upon mixing. To gain some insight into the several aggregations of molecular interactions present in these mixtures, the results were analyzed in terms of specific molecular interactions and mixing behavior between mixture components with taking into considerations the effect of temperature. Moreover, the thermophysical properties were examined with predictive and correlative equations. The quality of the

predictions for the studied systems was evaluated by measuring the deviations and drawing the comparison plots. This paper reports the variations of different physical and thermodynamic parameters for a mixture of PEGMA-300 in 2-methaxyethanol and 2-ethaxyethanol respectively.

Keywords :- Ultrasonic velocity, Excess Gibb's free energy of activation for viscous flow, Redlich-Kister polynomial equation.

❖❖❖

PS-II 1

Synthesis and Characterization of Aqueous Gold Nano Fluid Using Ultrasonic Technique

G.Nath[1*] and R. Paikaray[2]

[1]*Department of Physics, Veer Surendra Sai University of Technology, Sambalpur, Odisha, India*

[2]*Department of Physics, Ravenshaw University, Cuttack, Odisha, India*

*(*Email : ganesh_nath99@yahoo.co.in)*

Thermal management and energy storage systems are thrust areas of research in fields such as automobile/industrial cooling, renewable energy utilization. Nano size particles of less than 100 nm in diameter are currently attracting increasing attention for the wide range of new applications in various fields of industry. Such powders can exhibit properties that differ substantially from those of bulk materials not only in powder state but also a high significant result in fluid state. The unique properties like small particle dimension, high surface area, quantum confinement and other effects makes them well dispersed without agglomeration. An ultrasonic bath was used in this work to examine the feasibility of forming aqueous gold nanoparticles (GNPs) under atmospheric conditions. The effects of ultrasonic energy on the size and morphology of GNPs were investigated. Gold nanofluids with highly mono dispersed GNPs were successfully synthesized by sodium citrate reduction in a ultrasonic bath, without additional heating or magnetic stirring, as evidenced by ultraviolet–visible spectra and transmission electron microscopy and scanning electron microscope. Ultrasonic energy was shown to be a key parameter for producing gold nanofluids with tunable sizes (20 to 50 nm).Ultrasonic characterization includes measurement of ultrasonic velocity carried out by nano fluid interferometer operated at 2 MHz for different concentration and at different temperature. The acoustic parameters such as adiabatic compressibility, acoustic impedance, and free length are calculated related to the surface of nanoparticle and nanoparticle surfactant interaction. The results are discussed for predicting the enhanced thermal conductivity of the samples.

Keyword: Nano fluid, ultrasonic wave, acoustic parameter, thermal conductivity.

PS-II 2

Effect of Frequency on Molecular Interaction in Blended Nuclear Extractant

A. Sarangi [1], R.Giri [2] and G.Nath[2]

[1]*Dept. of, Chirst College, Cuttack -753001, Odisha, India*

[2]*Det. of Physics, Veer Surendra Sai University of Technology, Sambalpur, Odisha, India*

(Email: sarangi.abhijit@gmail.com,ganeswar.nath@gmail.com)

Due to unique physicochemical properties of the Rare earth materials (RRE), these are very essential elements in our nature. Now a day it is a challenge to extract these material from its commercial sources by using suitable method of extraction is a severe concern. Among all the methods solvent extraction is an easy and cost effective method for extraction. This paper aims to evaluate the optimum concentration range of the binary mixture of Methyl Iso Propyl Ketone (MIPK) and Carbon tetrachloride (CCl_4), which is suitable for extraction of RRE materials. Ultrasonic technique is very much helpful in this regard. By using the experimentally measured value of density, viscosity and ultrasonic velocity of the binary mixture for entire composition range for different frequency (1-4) MHz at a constant temperature 303.15 K, different acoustical parameters are evaluated, which explains the nature and strength of molecular interaction taking place between the liquid mixture of MIPK and CCl_4. By the analysis of this parameters and evaluating the extraction efficiency of the binary mixture we can easily get the optimum concentration range.

Keywords: Nuclear extractant, ultrasonic velocity, acoustic parameter, molecular interaction

❖❖❖

PS-II 3

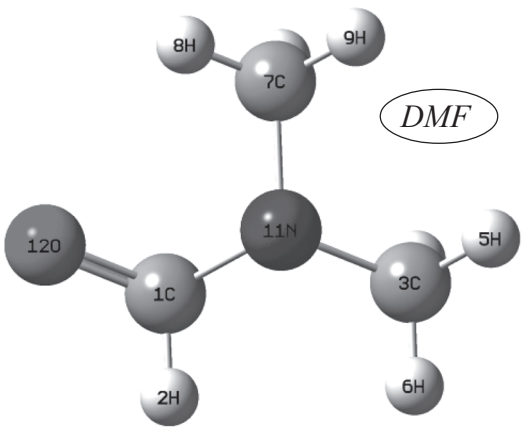
Thermoacoustical Analysis of Binary Mixtures of N-N- Dimethylformamide (DMF) with BAE and 1-BuOH

Sangeeta Sagar, Laxmi Kumari and Manisha Gupta*

Department of Physics, University of lucknow, Lucknow, U.P, 226007

*(*Corresponding author, e-mail: guptagm@rediffmail.com and sangeeta.sagar30@gmail.com)*

Ultrasound techniques are unique and find wide applications and acceptance in all fields. Applications of ultrasonic have made possible not only the evaluation of physico- chemical properties of the mixtures/ solutions but also more reliability on the interpretation of molecular interactions. In view of the wide scope of molecular interactions between the highly polar compound of N-N-Dimethylformamide (DMF) with Butylaminoethanol (BAE) and 1-Butylalcohol (1-BuOH), have measured thermophysical properties such as densities (ñ) and ultrasonic velocity (u) over the whole composition range at temperatures 293.15K, 298.15K, 303.15K, 308.15K and 313.15K under atmospheric pressure. To gain some insight into the several aggregations of molecular interactions present in these mixed solvents, deviation in ultrasonic velocity (Δu), excess intermolecular free length (L_f^E), excess acoustic impedance (Z^E) and excess Pseudo Grüneisen parameter (Γ^E) have been predicted. A qualitative analysis of the results is discussed in terms of the ion-dipole, ion-pair interactions, dispersive forces and hydrogen bonding prevailing in the binary mixtures.



Keywords: Ultrasonic, molecular interactions, thermophysical, deviation in velocity, excess Pseudo Grüneisen parameter.

❖❖❖

PS-II 4

Study of molecular interaction in binary liquid mixture at different temperature using ultrasonic technique

G. M. Jamankar and M. S. Deshpande

Department of physics, Anand Niketan College, Anandwan, Warora Dist. Chandrapur (M.S.), INDIA

(Corresponding Author Email: gm_jamankar@rediffmail.com, mil2des@yahoo.com)

Ellagic acid is influential bioactive compound with numerous potential pharmacological and industrial applications. In fruits and berries ellagic acid is a polyphenolic compound. Ultrasonic velocity (u), density (ρ) and viscosity (η) have been measured for the binary liquid mixture of ellagic acid with ethanol at temperature 298K, 303K, 308K and 313K for different molar concentration of component liquids using ultrasonic technique. From the experimental data adiabatic compressibility (β), free length (L_f), free volume (V_f), Rao's constant (R), Wada's constant (W) and van der Waal's constant (b) have been calculated. Non linear variation in these acoustical parameters for the binary mixtures is indicative of the nature and the strength of interaction in this binary system.

Keywords: Ellagic acid, Adiabatic compressibility, Free length, Wada's constant, Rao's constant.

❖❖❖

Thermoacoustical Parameters of Polybutadiene and Polymethyl Methacrylate Blends Using Toluene as Solvent

Sushama Patil[1*], M.S. Deshpande[2], O.P. Chimankar[3], and Sugandha Khangar[4]

[1, 3, 4] Acoustic Research Lab., Department of Physics, RTM Nagpur University, Nagpur, India
[2]Department of Physics AnandNiketan College, Anandwan, Warora, Chandrapur, India
*(*Email : sushamapatil1959@gmail.com)*

The compositional dependence of thermodynamic properties has proved to be very useful tool in understanding nature and pattern of molecular aggregation resulting from intermolecular interactions between components. In order to utilize polymers to create new multicomponent polymer systems the fundamental principles related with their microstructures, solubility, phase separation, thermodynamical properties and degradation must be studied. Such studies are useful for industrial development and solve technical problems and upgrade the products by working with existing materials. The molecular interactions study using low amplitude ultrasonic waves retain intrinsic state of polymer solution. The present paper deals with ultrasonic velocity, density, measurements performed on solution blends of Polybutadiene and Polymethyl Methacrylate in various blend ratios using Toluene as solvent. The measurements are done at 2MHz frequency and at temperatures 293K, 298K, 303K, 308K and 313K. Thermo-acoustical parameters viz. adiabatic compressibility (βa), acoustical impedance (Z), free length (L_f), relaxation time (τ), Internal pressure (P_i) have been computed from the experimental data. The variation of ultrasonic velocity and other thermo-acoustical parameters shows nonlinear increase or decrease with variation in blend ratio. The nature of polymer-polymer and polymer-solvent interactions and effect of blend ratio on molecular interactions have been studied.

Keywords: Ultrasonic velocity, Polybutadiene, Polymethyl Methacrylate, Blend ratio.

PS-II 6

Incidence of Ultrasonic wave through Newtonian and Non-Newtonian fluids

Md Sarowar Hossain[1], Animesh Basak[1], Barnana Pal[2] and P. K. Mukhopadhyay[1]

[1]LCMP, S.N. Bose National Centre for Basic Sciences, Salt Lake, Kolkata-106, India
[2]ECMP Division, Saha Institute of Nuclear Physics, Kolkata-64, India.
(Email : pkm@bose.res.in, sakil_phy@bose.res.in)

Apparent molar adiabatic compressibility (Φ_v) as well as bulk moduli (K) and apparent molar volumes (Φ_v) of glycerin-water, PEG-SiO_2, DMF-SiO_2 solutions at 27°C are evaluated in the present investigation. All the fluids are characterized by ultrasonic energy loss in terms of attenuation (α). Glycerin is a complex Newtonian medium due to its viscoelastic properties, so it is interesting to find the parameters as a function of concentration. We report on the measurement technique and discuss the interesting results here. The adiabatic compressibility of 10% glycerin in water was found to be $41.1\times 10^{-11}\ Pa^{-1}$ (K = 2.43GPa) including 1.86dB/cm/MHz of attenuation, less compared to pure water but the ultrasonic absorption coefficient ($\mu_a \approx 0.53$) of 10% glycerin in water is nearer to pure water. The other Non-Newtonian fluids show higher attenuation (>3dB/cm) and higher absorption ($\mu_a \approx 0.6$). All the measurements were done by using single transducer (Both transmitter and receiver) of 1MHz frequency.

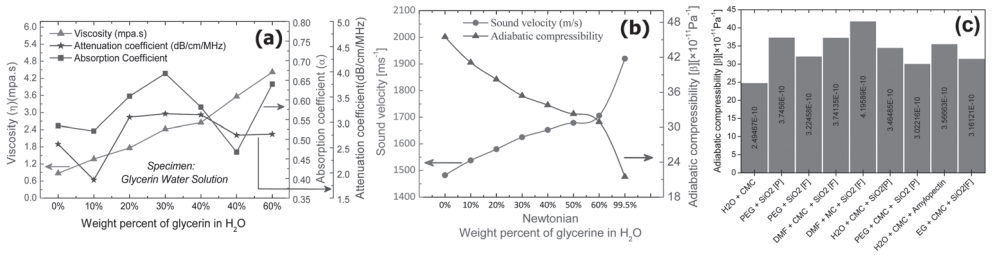


Fig.**(a)**: Ultrasonic attenuation, absorption and viscosity for different weight percentage of $C_3H_8O_3$
Fig.**(b)**: Ultrasonic velocity and adiabatic compressibility in Newtonian and Non-Newtonian fluids
Fig.**(c)**: Adiabatic compressibility in some Non-Newtonian fluids

Keywords: Viscous medium, ultrasonic velocity, sound attenuation, adiabatic compressibility.

PS-II 7

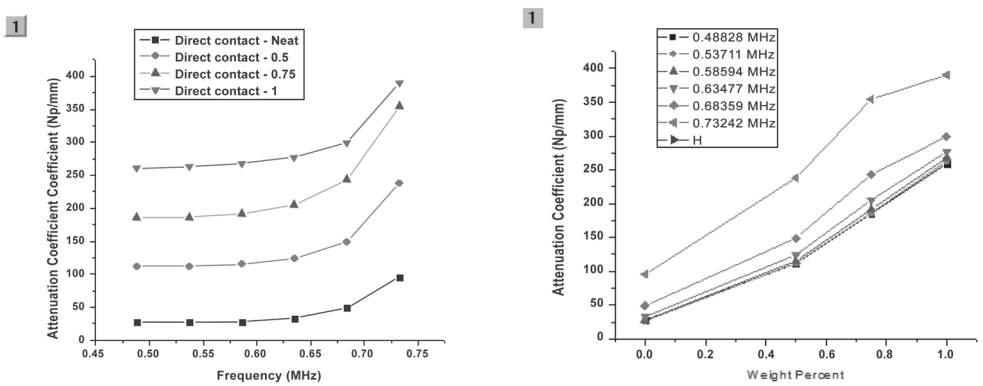
Study of Frequency and Concentration Dependence of Ultrasonic Attenuation Coefficient of NiO Nano-particle Embedded in PVDF (Polyvinilidyne Fluoride)

Chayan K Karmakar, Biplab Dutta, Sampad Mukherjee*

Department of Physics, IIEST shibpur, Howrah 711103

(Correspondence Author: Email-ID: smukherjee.besu@gmail.com)

In this work the frequency dependent attenuation coefficient of NiO embedded PVDF for different concentration by the ultrasonic through transmission technique has been studied. The NiO nano-particles have been prepared by hydrothermal route and the sample was stirred with PVDF solution (by using DMF as solvent) and the thin film was prepared by slow evaporation method. The sample having different concentrations as well as neat PVDF film was taken for Ultrasonic study. Then the amplitude vs time data has been collected from the Ultrasonic pulsar/receiver instrument USLT 2000 by A-scan process. The readings are taken by using the transducer of central frequency 500 KHz. To convert this data in time-domain to frequency- domain, Fast Fourier Transformation (FFT) has been done. By using the FFT data for each concentration, we use $\alpha = \frac{1}{l}\log_e \frac{A_0}{A_1}$, where α is the absorption coefficient in neper/mm, l is the thickness of the sample in mm, A_0 and A_1 are the power emitted by transmitter and received by receiver respectively.



Variation of Ultrasonic attenuation coefficient with frequency (Fig. 1) and with concentration (Fig. 2)

From the figure, the behavior of the absorption coefficient increases with the increase of concentration of the sample for a given frequency and this is obvious as the number density of the scatterer increases. Absorption coefficient increases with the increase of frequency for a given concentration of the sample as the scattering falls in the Rayleigh region ($\lambda >> a$, the particle size).

We are thankful to NASF (ICAR, GOI) for financial assistance.

❖❖❖

PS-II 8

Synthesis and Ultrasonic Characterization of CUO-PVA Nanofluids

Mathana Gopal.A[1*]., Poongodi .J[1]. and Pathinettam Padiyan .D[2]

[1]Department of Physics, Kamaraj College, Thoothukudi-628003, Tamilnadu

[2]Department of Physics, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamilnadu

(Email: [*]matgop04@gmail.com)

The molecular properties like transmission of sound in nanofluids undergo changes in highly associated systems and dependent on the cohesive properties of liquids. In the present investigation an attempt is made to calculate the ultrasonic velocity and density of the prepared nanoparticles at different weight percentage with the basefluid PolyVinyl Alcohol (PVA). Copper oxide (CuO) nanofluid was synthesized by transforming an unstable $Cu(OH)_2$ precursor to CuO in PVA under an ultrasonication. The result shows that CuO - PVA nanofluid can be synthesized using this method. The obtained dried precursor was annealed at 300°C. The annealed sample and the dried precursor were sonicated with an aqueous solution of PVA having concentration 4wt%. For comparison, the synthesized nanoparticles are characterized by X-Ray powder Diffractometry (XRD), Fourier Transform InfraRed Spectroscopy (FTIR), Diffuse Reflectance Spectroscopy (DRS) and analyzed. After ultrasonication UV-Visible Spectroscopy (UV-Vis), Ultrasonic velocity, density and adiabatic compressibility were analyzed and the results were discussed. There is a good agreement between the data produced by ultrasonic spectroscopy and other measurements.

Keywords: Nanofluid, Ultrasonication, Ultrasonic velocity, Density, Adiabatic compressibility.

❖❖❖

PS-II 9

Synthesis, Characterization and Antibacterial Activities of Co(II), Cu(II), Zn(II) Complexes Derived from Two Different Schiff Base

R. Muthukumar @ Sivaraman[1*] and I. Muthulakshmi[2]

[1]*Department of Chemistry, Kamaraj College, Tuticorin-628003, TamilNadu.*

[2]*Assistant Professor, PG Department of Chemistry, V.O.C. College, Tuticorin-628002, TamilNadu.*

(Email: [*]pearlpearl28392@gmail.com)

Two new Schiff bases were synthesized by condensation of benzaldehyde and anthranilic acid in one combination(1), salicylaldehyde and urea in another combination(2). Both bases were used to form distinctly colored complexes with the metal ions Co(II), Cu(II), Zn(II).Two Schiff bases and their metal complexes were characterized using Fourier Transform Infrared Spectroscopy. The FT-IR Spectral results indicate the formation of the metal complexes. All the metal complexes and ligands were screened for their antibacterial activity. Among them Zn-2 complex, Co-2 complex and Schiff base-2 showed good activity against certain three bacterial species.

Keywords: Schiff base, Metal complexes, Antibacterial activity.

❖❖❖

Acoustic Phonon Propagation and Interfacial Scattering in Nanostructures

Matukumilli V. D. Prasad[1*], Baidurya Bhattacharya[2]

[1]*Advanced Technology Development Centre, Indian Institute of Technology Kharagpur, W.B, India*

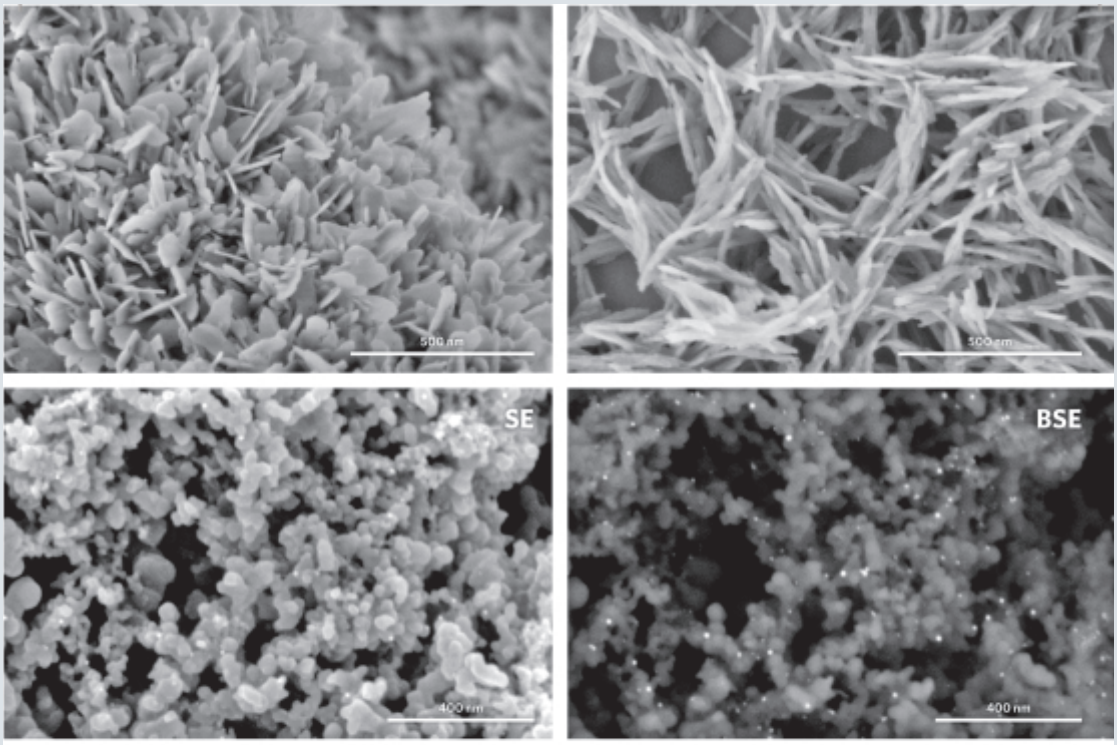
[2]*Civil Engineering Department, Indian Institute of Technology Kharagpur, W.B, India*

*(*E-mail: mvdprasad@iitkgp.ac.in)*

The phonon is the quantized mechanical vibration describing the fundamental transport mechanism of everyday sound and heat. Precise control of thermal transport by developing the ability to manage phonon spectrum is important across various research areas, including themoelectrics, phononic crystals, nanomechanical devices and acoustic cloaking. The nature of phonon propagation and its interfacial scattering are often poorly understood as the control of individual phonons *in situ* remains extremely challenging. The present study is based on classical molecular dynamics, where the phonon pulse is generated on a carbon nanotube either as spatial or spatiotemporal Gaussian wavepacket. We investigate how the propagating phonon of well-defined frequency and polarization interacts with the interfaces such as defects or co-axially placed other nanotube. The computed phonon transmission coefficients and visualized scattering events at different interface scenarios present the mechanistic understanding of non-Fourier type heat conduction. We show that the modified coherent phonon pulse approach provides unprecedented opportunities for simulating coherent phonon excitations in the femto-second laser experiments leading to a potential tool for manipulation of thermal transport and better design of phononic devices.

Keywords: Transient phonon transport, Acoustic phonons, Carbon nanotubes, Wave packets, Molecular dynamics

❖❖❖



Top left, *Hydroxyapatite crystals.* Sample courtesy of Devin Wu, FEI China and Shanghai Institute of Ceramics. **Top right, *Silica coated nanocellulose fibers.*** Sample courtesy of Dr. M.C.D. Mourad, TNO Eindhoven. **Bottom, *Pd nanoparticles in CeO2 matrix.*** Sample courtesy of Dr. Alessandro Lavacchi, CNR ICCOM.

Introducing the most versatile high-performance SEM

The Apreo™ compound lens yields unprecedented resolution and materials contrast by combining electrostatic and magnetic immersion technology.

The unique compound final lens delivers an exceptional resolution of 1.0 nm at 1 kV, without the need for beam deceleration — on any sample, even if it is tilted or topographic.

The most useful backscatter detection ensures that materials contrast is always available, even at low voltage and beam currents — at any tilt angle — on beam sensitive samples and at TV-rate imaging.

The widest range of charge mitigation strategies, including a low vacuum mode with a chamber pressure of up to 500 Pa to enable imaging of any sample.

Discover more at FEI.com/Apreo

FEI™

Explore. Discover. Resolve.

Bossa Nova Tech

From the surface inspection *using advanced vision* to the investigation of the core material integrity *using laser ultrasonics and optical interferometers*, **Bossa Nova Technologies** proposes a complete range of inspection systems.

LASER-BASED ULTRASONIC INSPECTION

FROM *INDUSTRIAL* TO *LABORATORY* LBU SOLUTIONS

TEMPO has been designed for precise *laboratory experiment*. It can measure ***in-plane*** and ***out-of-plane*** surface displacement with ultra sensitivity (Detection of sub-nm displacement), high frequency (up to 1 GHz) and excellent spatial resolution (down to 10 micrometer diameter spot on the sample)

QUARTET has been developed for *industrial applications*. Rugged, compact and insensitive to external perturbation, QUARTET allows the acquisition of ultrasonic signal in difficult industrial environment (On-line measurement on hot moving sample for example).

- Weld inspection
- Semi-conductors, MEMS characterization
- Quality control
- Thickness measurement
- Transducer characterization
- Flaws detection

POLARIZATION IMAGING

FROM *BIO-IMAGING* TO *3D RECONSTRUCTION* AND *ROBOTIC VISION*

SALSA performs live measurement of the full Stokes vector for each pixel of the image at a video frame rate. Many polarization-related parameters can be visualized in real time such as:

- Stokes parameters (S_0, S_1, S_2, S_3)
- Degree Of Polarization (Linear or Circular)
- Angle Of Polarization
- Ellipticity angle

SAMBA performs polarization difference imaging for each pixel of the image at a video frame rate. The observed scene is illuminated by a controlled source with a known polarization state. Many polarization-related parameters can be visualized in real time such as:

- Specular
- Diffuse
- Intensity
- Degree of polarization

CONTACT US FOR MORE INFORMATION

Bossa Nova Technologies
11922 Jefferson Blvd, Culver City, CA 90230, USA
Ph: +1 (310) 577-8113 – Fax: +1 (310) 943-3280 – info@bossanovatech.com,
www.bossanovatech.com

Nanotek Instruments
No.1.Mahalakshmi Avenue, Alappakkam II Main Road, Alappakkam
Chennai – 600 116, INDIA
Ph: +91-44-42152779, sales @nanotek.co.in

Designed & Printed at Sailee Press Pvt. Ltd. e-mail:saileepress@yahoo.com