

Photochemical, Thermochemical and Electrochemical splitting of water

C.N.R. Rao

Jawaharlal Nehru Centre for Advanced Scientific Research,
Bangalore (India)

Artificial photosynthesis is a promising method for producing renewable energy by use of sun light. Artificial photosynthesis employing the modified Z-scheme of natural photosynthesis can be exploited both for the oxidation and reduction of water. Oxidation of water is successively achieved by the use of cobalt and manganese oxides with the cations in the 3+ state with one e_g electron.^{1,2} Hydrogen can be produced by the dye-sensitized photochemical process³ or by the use of semiconductor heterostructures⁴. In this presentation, ways of splitting water will be presented, followed by recent results obtained on the photochemical generation of hydrogen by different strategies specially those involving semiconductor heterostructures of the type ZnO/Pt/CdS⁴ or nanosheets of chalcogenides^{3,5} such as MoS₂ and MoSe₂. Nanocomposites of MoS₂ with other 2D materials show improved HER activity.⁶ Recent results on hydrogen generation by the solar thermal route based on oxides are most encouraging.⁷ Replacing platinum in electrochemical HER by borocarbonitrides and other materials will be examined.^{8,9} An example of photoelectro chemical splitting of water will be presented.¹⁰

- 1) U. Maitra, B.S. Naidu, A. Govindaraj and C.N.R. Rao, PNAS, 110, 11704 (2013).
- 2) B.S. Naidu, U. Gupta, U. Maitra and C.N.R. Rao, Chem. Phys. Lett. 591, 277 (2014).
- 3) U. Maitra, U. Gupta, M. De, R. Datta, A. Govindaraj and C.N.R. Rao, Angew. Chem. Int. Ed. 52, 13057 (2013).
- 4) S.R. Lingampalli, U. Gautam and C.N.R. Rao, Energy Environ. Sci. 6, 3589 (2013).
- 5) U. Gupta, B.S. Naidu, U. Maitra, A. Singh, S. Shirodkar, U.V. Waghmare and C.N.R. Rao, Appl. Phys. Lett. (Materials), 2, 092802 (2014).
- 6) K. Pramoda, U. Gupta, M. Chhetri, A. Bandopadhyay, S.K. Pati and C.N.R. Rao, ACS Appl. Mater. Interfaces 9, XXX (2017).
- 7) S. Dey, B.S. Naidu and C.N.R. Rao, Chem-Euro J. (Hot Paper) 21, 7077 (2015).
- 8) M. Chhetri, S. Maitra, H. Chakraborty, U.V. Waghmare and C.N.R. Rao, Energy Environ. Sci. 9, 95 (2016).
- 9) M. Chhetri, S. Sultan and C.N.R. Rao, PNAS, In Print.
- 10) M. Chhetri, S. Dey and C.N.R. Rao, ACS Energy Lett., 2, 1062 (2017).



S. N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES KOLKATA

Director
and

Staff and students of S.N. Bose National Centre for Basic Sciences
request the pleasure of your company at Public Lecture

to celebrate

125th Birth Anniversary of Professor Satyendra Nath Bose

by

Prof. C. N. R Rao, FRS

National Research Professor, Linus Pauling Research Professor and
Honorary President of the Jawaharlal Nehru Centre for Advanced
Scientific Research (JNCASR), Bangalore, India

on

1st January, 2018 at 4.00 pm

To be followed by

Musical Program

Rabindra Sangeet by **Debashis Raychowdhury** and
Rohini Raychowdhury

Esraj by **Sewli Basu**

Prof. Samit Kumar Ray
Director

Venue:

Meghnad Saha Auditorium
Saha Institute of Nuclear Physics,
Sector - 1, Block - AF
Bidhan Nagar, Kolkata- 700064, India
Ph: 033 2335 5706/07/08

You are requested to kindly bring this invitation card.
Please take your seats by 3.30 pm. Car parking is not available.
This card is not transferable.

Professor C. N. R. Rao : Brief Profile



C.N.R. Rao (born on 30 June 1934, Bangalore, India) received the M.Sc. degree from Banaras, Ph.D. from Purdue, D.Sc. from Mysore universities. He is Honorary President and Linus Pauling Research Professor at the Jawaharlal Nehru Centre for Advanced Scientific Research. He is also an Honorary Professor at the Indian Institute of Science. His main research interests are in solid state and materials chemistry. He is an author of over 1650 research papers and 50 books. He has received honoris causa doctorate degrees from 77 universities including Purdue, Bordeaux, Banaras, Calcutta, Sri Venkateswara, Delhi, IIT Bombay, IIT Kharagpur, IIT Kanpur, IIT New Delhi, IIT Guwahati, IISERs (Bhopal, Kolkata, Mohali, Pune), Northwestern, Notre Dame, Novosibirsk, Oxford, Stellenbosch, Temple, Université Joseph Fourier, Grenoble, Uppsala, Wales, Wrocław, Caen, Liverpool, St. Andrews, Canberra, Taiwan and Desikottama from Visva-Bharati.

Prof. Rao is a member of several of the science academies in the world, including the Royal Society, London, the National Academy of Sciences, U.S.A., the Russian, French and Japan Academies as well as the American Philosophical Society. He is a Member of the Pontifical Academy of Sciences and Foreign Fellow of Academia Europaea, the Royal Society of Canada and the Chinese Academy of Sciences. He is a distinguished visiting professor of the University of California.

Among the various medals, honours and awards received by him, mention may be made of the Marlow Medal of the Faraday Society (1967), Bhatnagar Prize (1968), Padma Shri (1974), Royal Society of Chemistry (London) Medal (1981), Padma Vibhushan (1985), Honorary Fellowship of the Royal Society of Chemistry, London (1989), Blackett Lectureship of the Royal Society (1991), Einstein Gold Medal of UNESCO (1996), Linnett Professorship of the University of Cambridge (1998), Centenary Medal of the Royal Society of Chemistry, London (2000), Hughes Medal of the Royal Society, London, for original discovery in physical sciences (2000), Karnataka Ratna (2001), the Order of Scientific Merit (Grand-Cross) from the President of Brazil (2002) and the Somiya Award of the International Union of Materials Research (2004). He is the first recipient of the India Science Award by the Government of India and received the Dan David Prize for science in the future dimension for his research in Materials Science in 2005. He was named Chemical Pioneer by the American Institute of Chemists (2005), Chevalier de la Légion d'Honneur by the President of the French Republic (2005) and received the Honorary Fellowship of the Institute of Physics, London (2006) and of St. Catherine's College, Oxford (2007). He received the Nikkei Asia Prize for Science, Technology and Innovation in 2008 and was awarded the Royal Medal by the Royal Society (2009) and the August-Wilhelm-von-Hoffmann Medal by the German Chemical Society (2010). He received the Ernesto Illy Trieste Science Prize for materials research in 2011 and was Albert Einstein Professor of the Chinese Academy of Sciences in 2012. The President of India conferred the title Bharat Ratna in 2014. The Emperor of Japan bestowed the Order of the Rising Sun, Gold and Silver Star in 2015. He was conferred the highest award for materials research, the von Hippel award by the Materials Research Society in 2017. He is the first Asian to receive it.

Prof. Rao was Chairman, Scientific Advisory Council to the Prime Minister during 2004-2014 and also 1985-89. He was President of The Academy of Sciences for the Developing World (TAS). He is Founder-President of both the Chemical Research Society of India and of the Materials Research Society of India. Prof. Rao was President of the Indian National Science Academy (1985-86), the Indian Academy of Sciences (1989-91) and the International Union of Pure and Applied Chemistry (1985-97). He was the Director of the Indian Institute of Science (1984-94), and Chairman, Scientific Advisory Committee to the Union Cabinet (1997-98) and Albert Einstein Research Professor (1995-99)



FIRST JANUARY
2018

सत्येन्द्र नाथ बसु की 125 वीं जयंती

1894 - 2018

125th Birth Anniversary of Satyendra Nath Bose



सत्येन्द्र नाथ बसु राष्ट्रीय मौलिक विज्ञान केन्द्र
Satyendra Nath Bose National Centre for Basic Sciences