



Bose Colloquium

S. N. Bose National Centre for Basic Sciences
(An Autonomous Research Institute established under DST, GOI)



24th January, 2025



4.00 PM



Silver Jubilee
Hall



Webinar Link



YouTube Link

Science at the Nanoscale

Puru Jena

Virginia Commonwealth University, Richmond, Virginia

Abstract

The large surface to volume ratio of particles at the nanoscale offer unprecedented opportunities to design and synthesize materials with uncommon properties, which can be controlled with atomic precision in clusters - the ultimate nanoparticles. This talk will highlight some of unusual properties of nanoclusters by focusing on fundamental science¹⁻³: (1) Can a multiply charged cluster be stable and if so, what is the smallest size that can carry a fixed amount of charge? (2) Can nanoclusters with like charges attract? (3) Are noble gas atoms really noble? (4) Can atoms achieve oxidation states higher than nature intended? (5) Can salts be made with only negative ions? In addition, I will discuss how these unusual properties of nanomaterials can be leveraged to synthesize a new generation of cluster-assembled materials with a particular focus on Li-ion batteries⁴ and catalysts made of earth abundant materials^{5,6}.

- [1] Jena, P. and Sun, Q.: "Super Atomic Clusters: Design Rules and Potential for Building Blocks of Materials", Chem. Rev. 118, 5755-5870 (2018)
- [2] Zhong, M. M., Fang, H., and Jena, P.: "Super-electrophiles of Tri- and Tetra-Anions Stabilized by Selected Terminal Groups and Their Role in Binding Noble Gas atoms", Phys. Chem. Chem. Phys. 23, 21496 (2021)
- [3] Fang, H., Banjade, H., Deepika, Jena, P. "Realization of Zn³⁺ oxidation state", Nanoscale 13, 14041 (2021)
- [4] Fang, H., Jena, P.: "Argyrodite-type advanced lithium conductors and transport mechanisms beyond paddle-wheel effect", Nature communications 13 (1), 1-11 (2022) 10.1038/s41467-022-29769-5
- [5] Kilic, M. E.; Jena, P.: "Catalytic Potential of Supported Superatoms", Small 20, 2403888 (2024)
- [6] Kilic, M. E.; Jena, P.: "Superatoms as Superior Catalysts: ZrO vs Pd", Small (under review)

Speaker

Professor Puru Jena, Distinguished Professor of Physics and Founding Director of the Institute for Sustainable Energy and Environment at Virginia Commonwealth University (VCU), received B. Sc. (Hons) and M. Sc. from Utkal University and Ph. D. in Physics from the University of California at Riverside. He has been at VCU since 1980, with the exception of a year (1986-87) as a Program Director at the National Science Foundation and a year (2007-08) as Jefferson Science Fellow and Senior Science Advisor at the US Department of State. Dr. Jena's research covers a wide range of topics in nano-structured materials, condensed matter Physics, chemistry, and materials Science. He is the author of more than 700 papers including 14 edited books, with Google Scholar citations of 39,500 and H index of 98. His many honors include Elske v. P. Smith Distinguished Lecture, David Hare Professorship Lecture, BKM Memorial Lecture, Member of the National Academy of Investors, Professor A. K. Chandra Memorial Award from the Indian Chemical Society, Fellow of the American Physical Society, Outstanding Scientist of Virginia, Outstanding Faculty of Virginia, Presidential Medallion, University Award of Excellence and Outstanding Scholar from Virginia Commonwealth University. He has served as a member of numerous scientific panels at the National Academy of Sciences, National Science Foundation, Department of Energy, Army Research Office, and as Co-chair of the Presidential Commission on bilateral scientific collaboration between USA and Russia.

