



# Bose Colloquium



## S. N. Bose National Centre for Basic Sciences

(An Autonomous Research Institute established under DST, GOI)



### Title:

Cluster-based Functional Materials - A Paradigm shift in Design and Synthesis

### Abstract:

Although the Periodic Table of elements is the mother of all materials, it has limitations; the number of elements is limited, their chemistry is pre-determined and cannot be altered, and some of them are either rare or expensive. Atomic clusters, composed of a few to a few thousand atoms, provide a way to overcome these limitations, because their chemistry can be altered by tailoring their size, composition, and charge state. This talk will deal with the rational design of these superatomic clusters [1] and illustrate how their special symmetry and chemistry can provide an unprecedented opportunity to create materials with properties not possible by using atoms. The examples will include promoting unusual reactions such as making noble gas atoms form chemical bonds at room temperature [2], empowering atoms to achieve oxidation states higher than nature had intended [3], and enabling the synthesis of a new generation materials for energy production (e.g. solar cells) [4], energy storage (e.g., Li-ion batteries)[5], and energy conversion (e.g. thermoelectric materials)[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  $Zn^{3+}$  oxidation state", Nanoscale 13, 14041 (2021)
- [4] Fang, H. and Jena, P.: "Super-ion Inspired Colorful Hybrid Perovskite Solar Cells", J. Mat. Chem. A 4, 4728 (2016)
- [5] 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
- [6] T Li, T., Du, P.-H., Bai, L., Sun, Q., Jena, P.: "Record High Thermoelectric ZT of Superatomic Crystal  $Re_6Se_8I_2$  Monolayer", Phys. Rev. Applied (in press)

### Speaker:

**Prof. Puru Jena**

Virginia Commonwealth University, Richmond, Virginia

### About the Speaker

Professor Puru Jena is a Distinguished Professor of the Department of Physics, Virginia Commonwealth University. Prof. Jena received his Ph.D. in Physics from the University of California, Riverside in 1970. His research interests cover a wide range of areas in Physics, Chemistry, and Materials science starting from atomic clusters and nanomaterials to surfaces, interfaces, thin films, and defects in crystalline materials. Prof. Jena's honors include: Jefferson Science Fellow at the US Department of State, Fellow of the American Physical Society, etc.



18 January, 2023



4.00 PM



Webinar Link

YouTube YouTube Link

