

**Department of Chemistry, IIT Madras**  
**Ph.D. Research Colloquium**  
**(2<sup>nd</sup> Seminar)**  
**From clusters to extended solids: Emerging properties**

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**Date: 30.10.2019**

**Venue: CB 310**  
**Time: 3:00 pm**

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**Abstract**

Atomically precise clusters<sup>1</sup> of noble metals are considered to be an important class of advanced materials. Noble metal clusters (NMCs) composed of inorganic cores and organic ligands are fascinating owing to their tunable and unique properties.<sup>2</sup> To understand the unique properties of NMCs, it's important to know their total structure. The total molecular structure of NMCs obtained from single crystal X-ray diffraction is used to tune the electronic and surface properties. NMCs self-assembles to 1D nanofibrils which further congregate to form cluster assembled solids.<sup>3</sup> Can we use such cluster assembled solids as new functional materials? If so, how would their collective properties differ from individual building blocks? The crucial factor in assembling the cluster building blocks into solids are purity and quantity. In order to attain this, we have investigated the isolation of gold clusters with different ligand structure and charge-state using reversed phase HPLC.<sup>3</sup> We have worked extensively on modifying the building blocks with functional ligands which enables them to self-assemble into different nanostructures with enhanced NIR luminescence. Investigation on mechanical response of cluster assembled solids revealed the significant role of protecting ligands and their non-covalent interactions in turning their mechanical properties.<sup>4</sup> The precise controlling of structure and properties of nanoscale building blocks is key in developing the next generation of functional materials.

**References**

1. Jin, R.; Zeng, C.; Zhou, M.; Chen, Y., Atomically Precise Colloidal Metal Nanoclusters and Nanoparticles: Fundamentals and Opportunities. *Chemical Reviews* **2016**, *116* (18), 10346-10413.
2. Chakraborty, I.; Pradeep, T., Atomically Precise Clusters of Noble Metals: Emerging Link between Atoms and Nanoparticles. *Chemical Reviews* **2017**, *117* (12), 8208-8271.
3. Sugi K. S., S. B., Abhijith Nag, Ganesan Paramasivan, Ananthu Mahendranath and T. Pradeep, Ligand structure and charge state-dependent separation of atomically precise Au<sub>25</sub> clusters using non-aqueous reversed phase HPLC. (*Under review*) **2019**.
4. Sugi, K. S.; Mallikarjunachari, G.; Som, A.; Ghosh, P.; Pradeep, T., Probing the Mechanical Response of Luminescent Dithiol-Protected Ag<sub>29</sub>(BDT)<sub>12</sub>(TPP)<sub>4</sub> Cluster Crystals. *ChemNanoMat* **2018**, *4* (4), 401-408.

  
Guide

  
Seminar Coordinator

  
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