Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Internal Webinar

Synthesis and Photophysical Applications of Luminescent Copper(I) Iodide Clusters

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Luminescent copper(I) complexes are increasingly recognised for their utility in various applications such as organic light-emitting diodes (OLEDs), electrochemical cells, and biological imaging. They offer a cost-effective alternative to traditional phosphorescent materials based on expensive noble metals like iridium and platinum. Despite the absence of a pronounced "heavy atom" effect, copper(I) complexes exhibit efficient room-temperature phosphorescence, enabled by their $3d^{10}$-electronic configuration and adaptable coordination environments. Copper iodide clusters have shown significant promise as emitters, forming diverse structures ranging from dimeric and tetrameric to polynuclear assemblies. The ability of iodine to bridge copper atoms supports this structural diversity, yielding architectures that are ideal for photophysical applications. Initial studies using monodentate ligands, such as pyridine and phosphine, achieved high quantum yields but suffered from poor stability in OLED devices. To address these challenges, rigid bidentate ligands, including pyridine chelated phosphines, were introduced, enhancing stability but involving costly and complex synthetic routes. These often required rare metal catalysts, hazardous reagents, and strict conditions. An alternative approach involves pyridine-chelated N-heterocyclic imine ligands (Py^NHC=NCH_2Ph), which are simpler to synthesize, eliminate the need for harsh reagents, and offer tenable steric and electronic properties. By modifying these ligands through N substitution, researchers can optimize copper(I) complexes for stable, efficient emission in OLED applications, paving the way for more practical and economically viable optoelectronic materials.

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