Jawaharlal Nehru University

Special Centre for Nanoscience

Photoluminescence Behavior Combined with Multiple Electrical and Optical Properties in Organic-Inorganic Hybrid Manganese (II) Halide Perovskite

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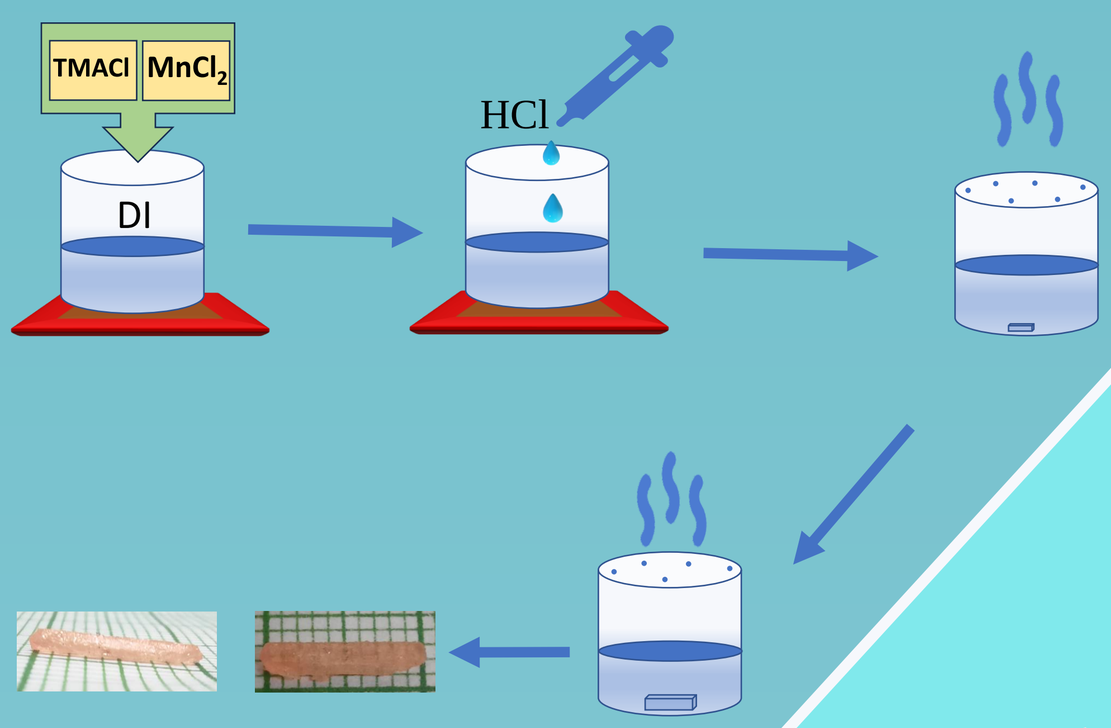
Abstract & Motivation

Organic-inorganic hybrid materials have emerged as a potential candidate due to their fascinating properties for several optoelectronic applications such as Light Emitting Diodes, Scintillators, X-ray detectors, gamma ray detectors as well as solar cell applications with a remarkable power conversion efficiency. These substances have demonstrated significant promise in the field of sensing technologies, energy storage systems, research on magnetism, scintillation detectors, piezoelectric devices, and have also garnered attention for their notable qualities such as high photoluminescence and quantum yield. Cutting-edge research has focused on photoluminescent organic-inorganic hybrids, and these studies have uncovered that their luminescent mechanism provides substantial advantages when compared to conventional photoluminescent materials doped with rare earth elements. A thorough investigation and understanding of the underlying physical processes in $[N(CH_3)_4]MnCl_3$ are essential for optimizing the material's performance in optoelectronic and dielectric applications. Therefore, Impedance spectroscopy in combination with the modulus spectroscopy has been employed to study the charge carrier mechanisms and dynamics associated with the dielectric behaviour of the material at different temperatures.

Organic-inorganic hybrid fluorescent materials with superior optoelectronic properties could be used for rewritable luminescent printing and Light Emitting diodes

Synthesis Schematics

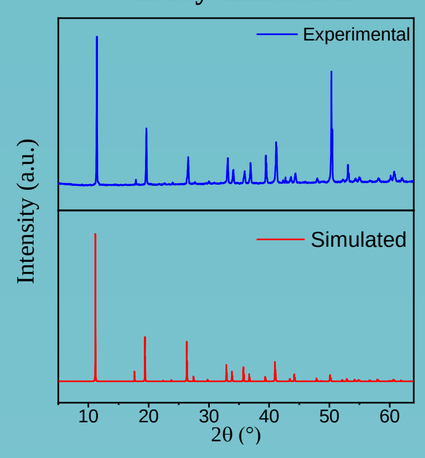
Slow Evaporation Method

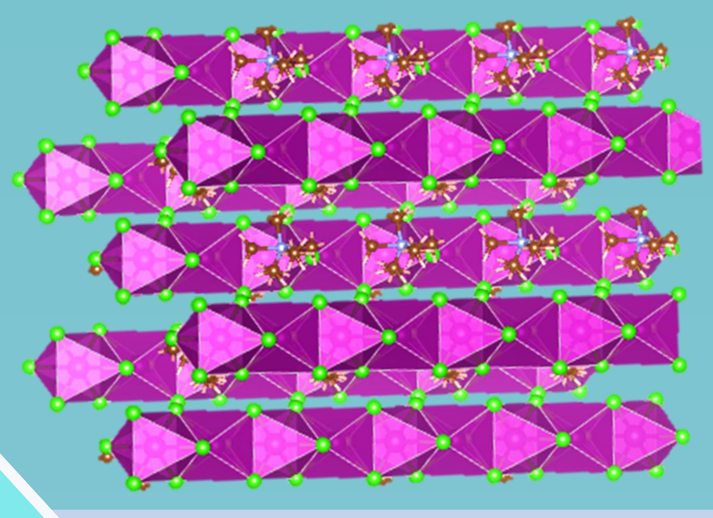


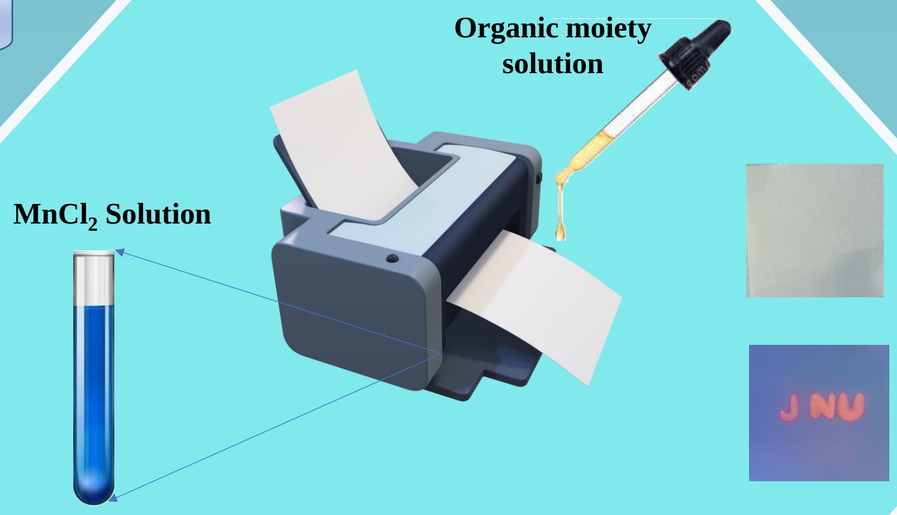
Crystal Structure

- Centrosymmetric space group
- P63/m
- Face sharing octahedra
- Hexagonal crystal system

X-ray diffraction



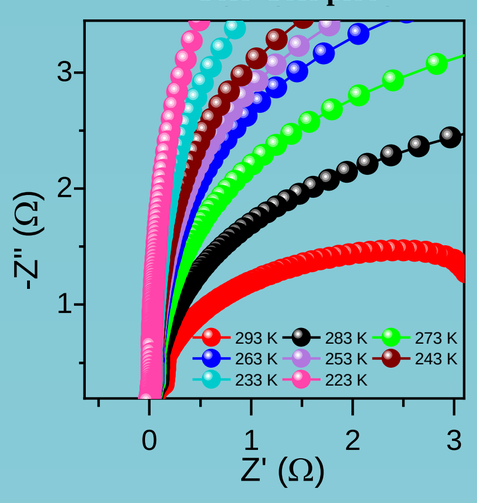




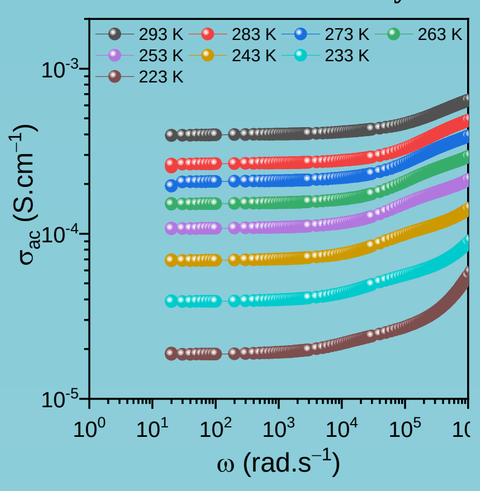
Photoluminescent Printing

Electrical Property

Cole-Cole plot

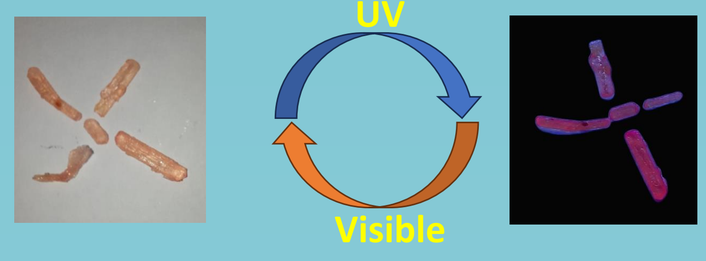


Electrical Conductivity

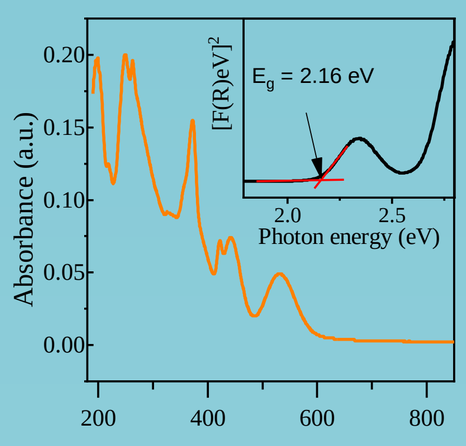


Optical Property

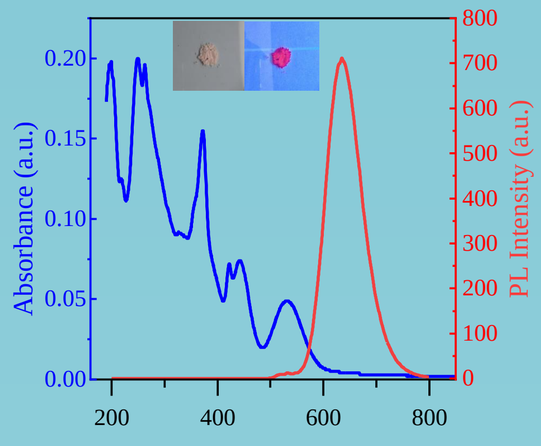
Fluorescent crystals



Kubelka-Munk plot



PL Emission



Acknowledgements

Kulhary Dinesh expresses gratitude to the UGC (University Grants Commission) in India for providing the research scholarship. The authors extend their sincere appreciation to Dr. Anil Yadav for his assistance with characterization. K. Dinesh would also like to thank Dr. Devthade Vidyasagar, Amit Yadav, and Dr. Ashok Shende for their valuable suggestions.

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Conclusions

In summary, we reported a lead free Mn based organic-inorganic $[(CH_3)_4N]MnCl_3$, which crystallizes in the hexagonal crystal system with P 63/m space group. This compound possesses a unique emission band at 635 nm and we assign the emission peak to Mn^{2+} d-d transition radiation. Moreover, $[(CH_3)_4N]MnCl_3$ SCs show a PL characteristics, that is, it shows a bright red emission at room temperature. Thermogravimetric analysis revealed that the compound is stable up to a temperature of 400 K. The activation energy was calculated using the Coats-Redfern method and found to be 33.6 kJ/mol.

We are open for collaboration in all types of capacities.