Metal halide perovskite (MHP) quantum dots and nanocrystals for luminescence and photovoltaic applications

Metal halide perovskites (MHPs) have garnered great attention for their impressive luminescence and photovoltaic performance. Although discovered in the late 19th century, the real potential of MHPs was identified just a decade ago. These materials prove to be the next generation of photonics and optoelectronic devices for their improved skyrocketed performances that pose a competition to the existing generation of devices. Despite its countless advantages, perovskite nanocrystals (PeNCs) and quantum dots (QDs) have faced issues with its stability and applicability. Researchers all around the globe are probing for ways to improve the stability of MHPs by introducing novel synthesis strategies, capping agents, encapsulation, varying of the precursors, etc.

Lead-halide perovskites (LHPs) have shown the greatest potential among all the MHPs. By tuning the composition of the halides (X = Cl, Br, I), it is possible to tune the color emission from blue to red. However, the lead-toxicity discourages the use of LHPs to commercial applications and hence, other alternatives with less-lead or lead-free compositions are being investigated. In our pursuit to prepare high quality MHP NCs, we have adopted wet chemical methods by dissolving the precursor salts in the organic solvents. Our plans involve the synthesis of LHPs and lead-free perovskites, double perovskite NCs and QDs by different methods such as Ligand-assisted reprecipitation (LARP), emulsion synthesis, Ultrasonication bath, hot-injection (HI).

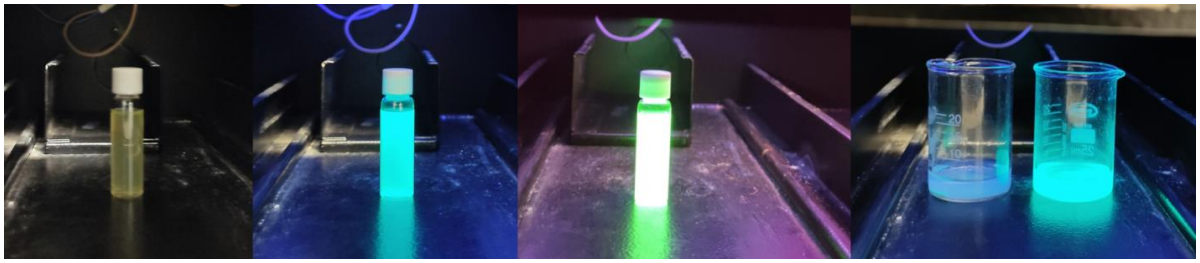

Fig. 1 $CsPbX_3$ (X = Cl, Br) QDs under normal light and 360 nm NUV.

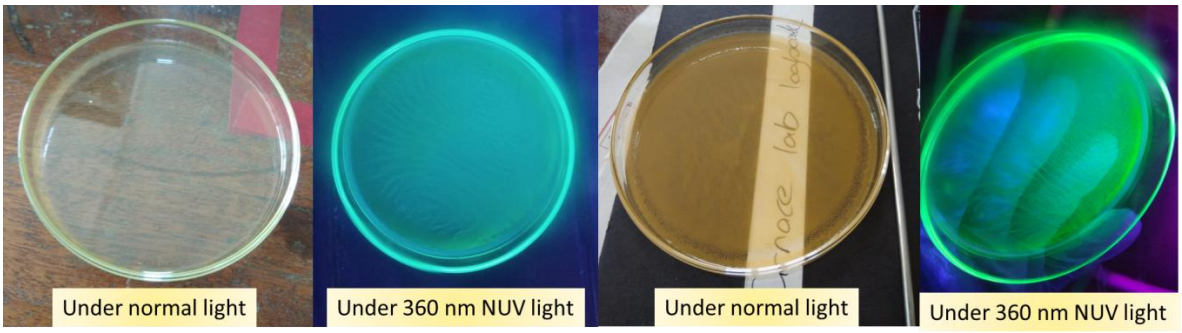

Fig. 2 $CsPbX_3$ (X = Cl, Br) NCs under normal light and 360 nm NUV.

Dr. Govind B. Nair

Dr. Govind B. Nair is an NRF Y-rated Post-Doctoral researcher working in the Department of Physics, University of the Free State, Bloemfontein, South Africa under the supervision of Prof. H. C. Swart from 2018. He obtained his Masters' degree in Physics from R.T.M. Nagpur University, Nagpur in 2014, India. He bagged two gold medals for securing first rank in his Masters degree. He pursued his PhD from R.T.M. Nagpur University under the guidance of Prof. S. J. Dhoble in 2018. He was awarded with INSPIRE Fellowship, a prestigious fellowship programme conducted by the Department of Science and Technology (DST), India. He is credited with 39 research papers in SCOPUS-indexed journals with high repute. He published a reference book on the *Fundamentals and Applications of Light–emitting diodes* with Elsevier in 2020 under the imprint of Woodhead publishing. He was also awarded with the Summer Research Fellowship by the Indian Academy of Sciences (IASc) in 2012 to work on a project in Raja Ramana Centre for Advanced technology (RRCAT), Indore, India. His area of research includes the synthesis and characterization of Optical materials, theoretical analysis of luminescence processes, structural analysis of materials, etc.