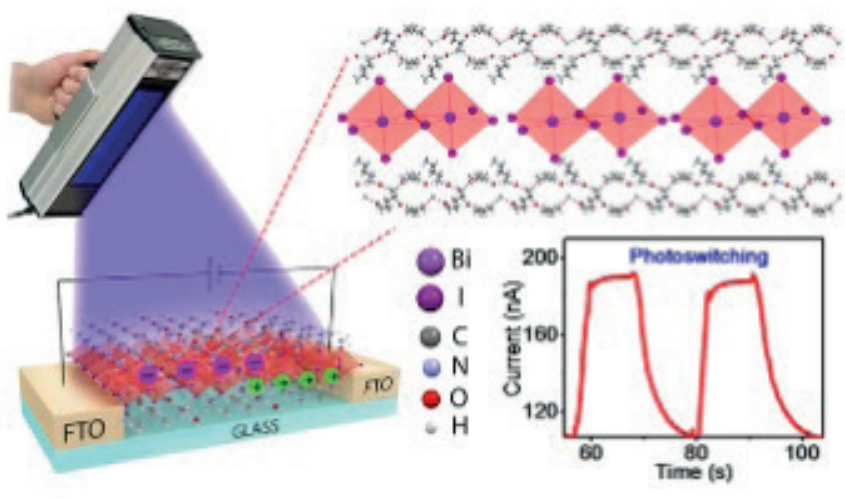
ZERO-DIMENSIONAL LEAD-FREE HYBRID PEROVSKITE WITH QUANTUM-WELL STRUCTURE: SYNTHESIS, OPTOELECTRONIC PROPERTIES AND APPLICATIONS

Vijayakumar C. Nair*, Johnpaul K. Pious, Chinnadurai Muthu

Photosciences and Photonics Section, CSIR-National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram 695 019, India.
E-mail: cvijayakumar@niist.res.in

Low-dimensional hybrid perovskites are an emerging class of materials with high stability and excellent optoelectronic properties.[1,2] Recently, we have designed and synthesized a novel, lead-free, zero-dimensional perovskite, (1,3-propanediammonium)-$_2Bi_2I_{10}.2H_2O$, for optoelectronic applications.[2] This material exhibited good moisture and thermal stability under ambient conditions. Single crystal X-ray diffraction analysis revealed a quantum-well structure having the inorganic $Bi_2I_{10}^{4-}$ clusters are periodically arranged in the crystallographic 'c' axis separated by a distance of 5.36 Å, sandwiched by independent layers of organic cations. The density functional theory calculations showed that the oxygen in water molecules have a significant contribution to the band edges of the material. Emission and Raman spectroscopy analysis revealed the presence of trap states in the material formed due to the strong excited electron-phonon coupling. Photodetector device fabricated using this material showed an efficient charge separation at low voltage (1V) due to the good electronic conduction between the $Bi_2I_{10}^{4-}$ dimer units. Use of this material for neuromorphic computing is currently under progressing. Details will be presented.



1. G. Grancini, M. K. Nazeeruddin, Nat. Rev. Mater. 2019, 4, 4-22.
2. J. K. Pious, M. L. Lekshmi, C. Muthu, R. B. Rakhi, V. C. Nair, ACS Omega 2017, 2, 5798–5802.
3. J. K. Pious, A. Katre, C. Muthu, S. Chakraborty, S. Krishna, V. C. Nair, Chem. Mater. 2019, DOI: 10.1021/acs.chemmater.8b04642.