Exploring lead-free liquid-ionic perovskite crystals as novel scintillators

Mohanad S. Eid[1#], Konrad. J. Drozdowski[1], Marcin E. Witkowski[1], Ricky Subagyo[2], Arramel[3], Yuly Kusumawati[2], Dominik Kowal[4], Michal Makowski[4], M. Danang Birowosuto[4], Winicjusz Drozdowski[1]

[1]Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University in Toruń, ul. Grudziądzka 5, 87-100 Toruń, Poland
[2]Department of Chemistry, Faculty of Science and Data Analytics, Institut Teknologi Sepuluh Nopember, Kampus ITS Keputih, 60111 Sukolilo, Surabaya, Indonesia
[3]Nano Center Indonesia, Jl PUSPIPTEK, South Tangerang, Banten 15314, Indonesia
[4]Łukasiewicz Research Network-PORT Polish Center for Technology Development, ul. Stabłowicka 147, 54-066 Wrocław, Poland

The exploration of hybrid organic-inorganic perovskites (HOIPs) within the context of scintillator materials presents a novel avenue in materials science. In addition, by combining the unique properties of ionic liquid (IL)-based organic cations with lead-free perovskite we can leverage the unique properties of these compounds such as tunable bandgaps and large stokes shift with a small probability of reabsorption of scintillation light since the overlap absorption and emission spectral area is smaller.

In this study we aimed to investigate the potential of ionic liquid lead-free perovskite embedded within PDMS (polydimethylsiloxane) matrix as promising candidates for scintillator applications. The samples under investigation included a variety of compositions: *a)* $BMPBiBr_4$, *b)* $APIBiBr_5$, *c)* $APIBiSnBr_5$, *d)* $BMIBiBr_4$, and *e)* $APISn_2Br_{10}$. The primary motivation behind this investigation arises from their lead-free nature, which addresses environmental concerns of using lead-based materials. Additionally, these perovskite microcrystals exhibit a substantial Stokes shift of approximately 0.8 eV, indicating potential for efficient light emission and detection.

By characterization and evaluation of the scintillation properties of these materials, using such techniques as pulse height spectra, scintillation time profiles, radio- and thermoluminescence measurements, our findings may lead the way for the development of next-generation radiation detection systems with improved performance and reduced environmental impact, marking a significant step forward in the field of radiation detection.

corresponding author: mohanadeid@doktorant.umk.pl