Polymer-Enhanced $Cs_3Cu_2I_5$ Perovskite Scintillator Films with Improved Stability and X-Ray Imaging Quality

Ha Neul Kim[1], Seong Ho Lee[2], Hyekyoung Choi[3] , Ju Young Woo[2,4] , Bo Kyung Cha[5,*] and Seong-Yong Cho[1,2,*]

[1]*Department of Photonics and Nanoelectronics and BK21 FOUR ERICA-ACE Center, Ansan, Republic of Korea*
[2]*Department of HYU-KITECH Joint Graduate school, Ansan, Republic of Korea*
[3]*Energy Conversion Research Center, Electrical Materials Research Division, Korea Electrotechnology Research Institute (KERI), Changwon, Republic of Korea*
[4]*Autonomous Manufacturing & Process R&D Department, Korea Institute of Industrial Technology (KITECH), Ansan, Republic of Korea*
[5]*Precision Medical Device Research Center, Korea Electrotechnology Research Institute (KERI), Ansan, Republic of Korea*
Corresponding Author Email: gksmf6137@hanyang.ac.kr

Scintillators convert high-energy radiation such as X-rays into visible light and are essential for applications in medical imaging, industrial non-destructive testing, and security screening. However, conventional scintillators—including $Bi_4Ge_3O_{12}$, $CdWO_4$, BaF_2, CsI:Tl, and NaI:Tl—are limited by high-temperature single-crystal growth, toxicity or rare-earth element incorporation, and insufficient chemical stability.[1]

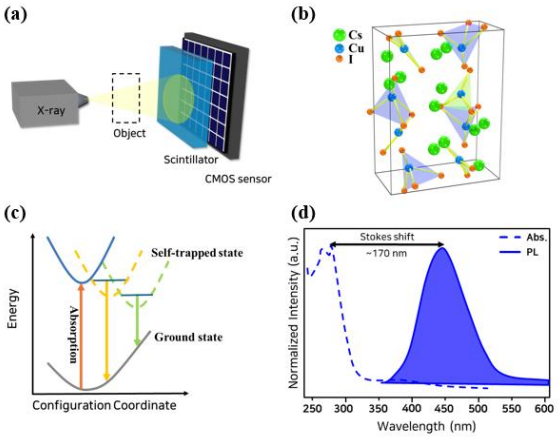

Figure 1. *(a) Schematic illustration of a scintillator-based X-ray imaging system, (b) crystal structure and optical properties of $Cs_3Cu_2I_5$, (c) formation of self-trapped excitons (STEs) induced by lattice distortion in copper-based halide perovskites, and (d) the resulting large Stokes shift that suppresses self-absorption.*

Halide perovskites have recently emerged as attractive candidates for next-generation scintillators due to their strong absorption of high-energy photons, fast emission dynamics, and structural tunability**. Copper-based halide perovskites** adopt zero-dimensional (0D) crystal structures that promote strong lattice distortion and the formation of **self-trapped excitons (STEs).** This results in broadband emission with a **large Stokes shift**, effectively suppressing self-absorption—one of the primary efficiency-limiting factors in conventional and lead-based perovskite scintillators.

Owing to their STE-mediated photophysics and intrinsically non-toxic composition, copper-based halide perovskites exhibit highly efficient scintillation with excellent quantum yields. These results highlight copper-based halide perovskites as a promising, environmentally benign scintillator platform for radiation detection in medical, industrial, and security applications.

1. Li, N., Xu, Z., Xiao, Y., Liu, Y., Yang, Z., & Liu, S., “Flexible, High Scintillation Yield Cu3Cu2I5 Film Made of Ball-Milled Powder for High Spatial Resolution X-Ray Imaging,” *Adv. Optical Mater.*, **10**, 2102232 (2022).

Acknowledgments
This research was supported by Korea Electrotechnology Research Institute (KERI) Primary research program through the National Research Council of Science & Technology (NST) funded by the Ministry of Science and ICT (MSIT) (No. 25A01103), Korea Institute for Advancement of Technology grant funded by the Korean Government (MOTIE) (RS-2025-02263458, HRD Program for Industrial Innovation), Korea Basic Science Institute (National Research Facilities and Equipment Center) grant funded by the Ministry of Education (grant No.2021R1A6C101A405).