Contribution ID: **42** Type: **not specified**

Fast timing with nanocrystalline lead halide perovskite thin films on scintillating wafers

Saturday, June 4, 2022 12:00 PM (15 minutes)

In recent years the need for ultrafast detection of ionizing radiation is being pushed particularly by high energy physics and medical imaging. It requires detection systems involving scintillating materials able to produce quasiprompt photons. To achieve that, there are several concepts currently being pursued, one of them being exploitation of quantum confinement effect in nanoparticles. Eventually one can create heterostructures combining nanocrystalline material with standard dense scintillators having the high stopping power for ionizing radiation.

Lead halide perovskite nanocrystals of the formula CsPbBr3 have recently attracted attention as potential time taggers in such scintillating heterostructures thanks to their ultrafast decay kinetics. We investigate the potential of this material experimentally. We fabricated CsPbBr3 thin films on scintillating GGAG:Ce (Gd2.985Ce0.015Ga2.7Al2.3O12) wafer as a model structure for the future sampling detector geometry. We focus on the radioluminescence (RL) response of such composite material. We compare the results of two spin-coating methods, namely the static and the dynamic process, for the thin film preparation. We demonstrate enhanced RL intensity of both CsPbBr3 and GGAG:Ce scintillating constituents of a composite material. This synergic effect arises in both the RL spectra and decays. Our study confirms that the thin nanocomposite layer is able to perform as efficient time tagger in the sandwich detector for ultrafast timing applications.

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Session Classification: Technologies for ≤100ps TOFPET resolution: Scintillators

Track Classification: Technologies: Scintillators