Study of a hybrid organic-inorganic system for X-ray detection

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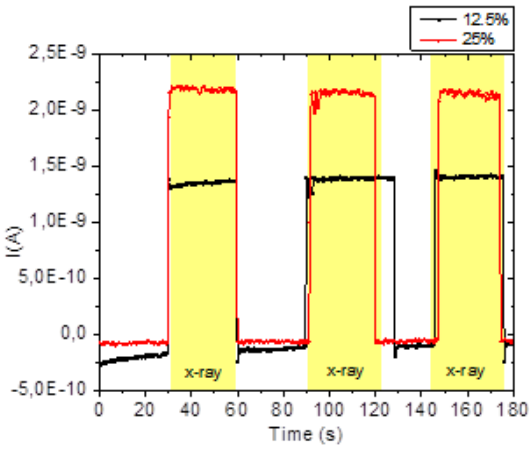
The development of X-ray radiation detectors is an active field of modern research due to their wide range of possible applications in modern medicine, security control and scientific research. Currently used semiconductor crystal X-ray detectors have several negative properties such as a limited size, high operating voltages, poor X-ray absorption capacity and no plasticity and flexibility. These problems can be solved by developing new types of hybrid X-ray detectors consisting of high-Z nanoparticles arranged in an organic matrix.

In this study, we developed and tested hybrid organic-inorganic thin-film systems operating by converting incident X-ray photons into the current. Hybrid systems were formed from tungstate nanoparticles of various metals (cadmium, zinc, nickel, strontium, calcium, cobalt) and various organic compounds - poly(3-hexylthiophene-2,5-diyl) or P3HT, Phenyl-C61-butyric acid methylester or PCBM (fullerene), Poly(9-vinylcarbazole) or PVK and poly(3,4-ethylenedioxythiophene) polystyrene sulfonate or PEDOT:PSS.



X-ray generated photocurrent of hybrid systems $CaWO_4$+P3HT/PCBM with 12.5 and 25 wt% $CaWO_4$ nanoparticles.

Thin-film samples were fabricated from a solution by the blade casting method. Scanning electron microscopy was used to characterize the nanoparticles and their distribution in an organic matrix. The X-ray detection capability and sensitivity of hybrid systems were determined using radiation from an X-ray tube with a tungsten anode. Current-voltage characteristics and X-ray current curves were obtained during the operation, and the sensitivity of the obtained systems was calculated. The obtained results are compared with the state-of-the-art data available in the literature.

The financial support provided by the Latvian Council of Science project No. lzp-2019/1-0071 is greatly acknowledged.