Ionizing radiation sensors based on semiconducting organic single crystals

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Ionizing radiation (e.g. X-rays, electrons and alpha particles) can be detected by directly converting it into an electrical signal. Presently, only few and expensive inorganic semiconductors (e.g. CdTe, SiC) offer the possibility of realizing portable detectors that operate at room temperature. Organic semiconductors have been so far mainly proposed as detectors for ionizing radiation in the indirect conversion approach, i.e. as scintillators, which convert ionizing radiation into visible photons, or as photodiodes, which detect visible photons coming from a scintillator and convert them into an electrical signal. The direct conversion of ionizing radiation into an electrical signal within the same device is a more effective process than the indirect one, since it improves the signal-to-noise ratio and it reduces the device response time. We report here the use of organic semiconducting single crystals (OSSCs) as intrinsic direct ionizing radiation detectors, thanks to their stability, good transport properties and large interaction volume. Ionizing radiation X-ray detectors, based on low-cost solution-grown OSSCs are here shown to operate at room temperature, providing a stable linear response with increasing dose rate in atmosphere and in radiation-hard environments [1]. 2D ionizing radiation detector matrixes can be fabricated on plastic substrates with inkjet printed electrical contacts and can be operated at very low voltages (<10V). The intrinsic conversion of ionizing radiation within the crystals allowed to fabricate all-organic optically transparent devices, indicating OSSCs as very promising candidates for a novel generation of low-cost, room temperature, portable ionizing radiation detectors.

[1] B.Fraboni et al. Adv.Mater. **24**, 2289 (2012)