Flexible Organic X-ray detectors

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The light weight, simple processability, and mechanical flexibility of π-conjugated organic small molecules and polymers has recently led to remarkable research efforts towards realizing new opto-electronic devices. In recent years, the first studies on the employment of organic materials as direct detectors of the ionizing radiation, i.e. its direct conversion into an electrical signal, have been proposed and we reported about the performances of solution-grown Organic Semiconducting Single Crystals (OSSCs) as direct X-ray detector, operating at room temperature and in atmosphere, showing a stable and linear response with increasing dose rate. The results obtained so far with organic single-crystal based detectors paved the way not only to a deeper understanding of the X-ray photon-to-electron conversion processes in organic materials, but also to the development of a new class of organic-based direct detectors with higher performances. Therefore, in order to easily scale the dimensions of our detectors, and to exploit light weight, simple processability, and mechanical flexibility of organic materials, we are now focusing on the study of devices fabricated by the employment of easy, low temperature and low cost technologies as inkjet printing, over flexible substrates as polyethylenetherephtalate (PET). TIPS-pentacene (6,13-Bis(triisopropylsilylethynyl)pentacene) is the suitable candidate for this purpose for its excellent solubility in several common organic solvents and its processability at low temperature (up to 80°C), which allow to employ thin plastic flexible foils as substrates. We will report about the first results on the employment of TIPS-pentacene based, fully bendable, devices as direct X-ray detectors, obtaining sensitivity values up to several hundreds of nC/Gy at very low bias of 0.2 V. We also assess the possibility to use the detector under mechanical strain and give the first demonstration of a 2×2 pixelated matrix detector.