Highly flexible perovskite/microbead hybrid photodetectors with improved optical responses by interfacial light trapping

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Perovskite-based photodetectors play a crucial role for sensing and imaging among various photovoltaic applications. Despite the advantages in terms of fabrication, mechanical flexibility, and reproducibility, the two-terminal device exhibit low responsivity compared to the vertical devices. In this study, we introduce a simple procedure for the design of high-performance, low-power, and flexible perovskite photodetectors by applying an assembled polymeric microbead monolayer. Transfer-printed polystyrene (PS) microbeads enable the electromagnetic field to be confined in perovskite. The responsivity, detectivity, and noise equivalent power (NEP) of the photodetector increased to over 8.5 times, due to the enhanced photoluminescence properties of perovskite. The polarization-insensitive light absorption of perovskite by the PS bead layer also promotes excellent omnidirectionality with respect to the incident light at different angles. Furthermore, PMMA/PS layer provides improved mechanical durability at a submilimeter bending radius (r). After 20 bending cycles at r = 0.2 mm, the device performance retained 81.5% of the initial values.