Interfacial toughening strategy for high stability 2D/3D perovskite X-ray detectors with carbon nanotube thin film electrode

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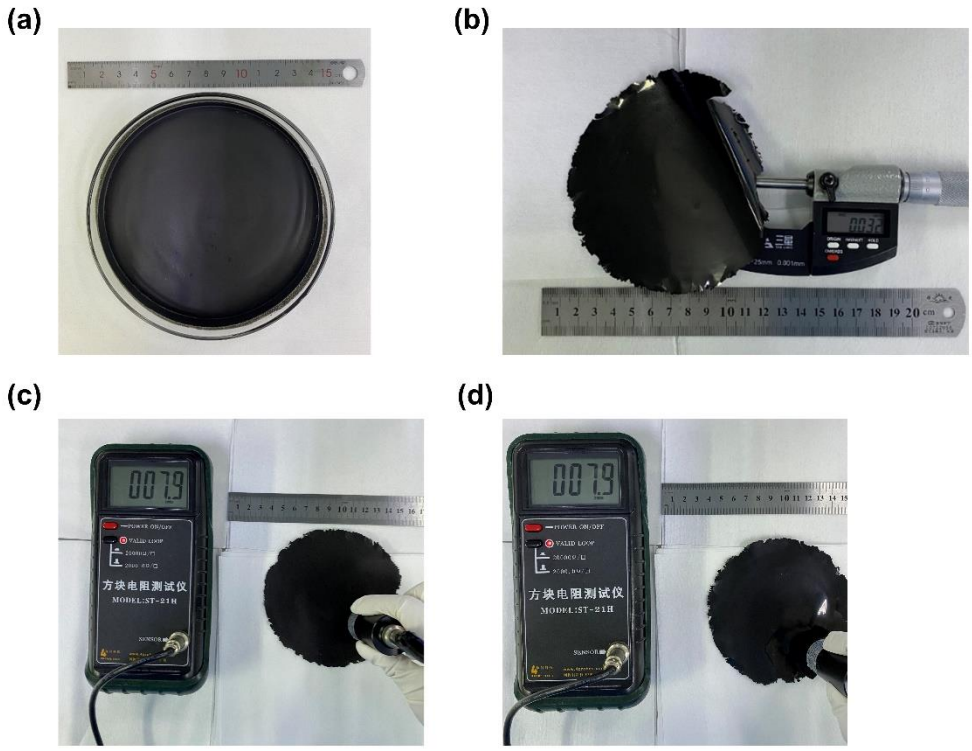

Figure S1. The photographs of the as-prepared CNT-film (a), the thickness of the prepared CNT-film measured by micrometer (b), the sheet resistance of rough surface (c) and the reflective surface (d) of the prepared CNT-film measured by the four-probe measurement.

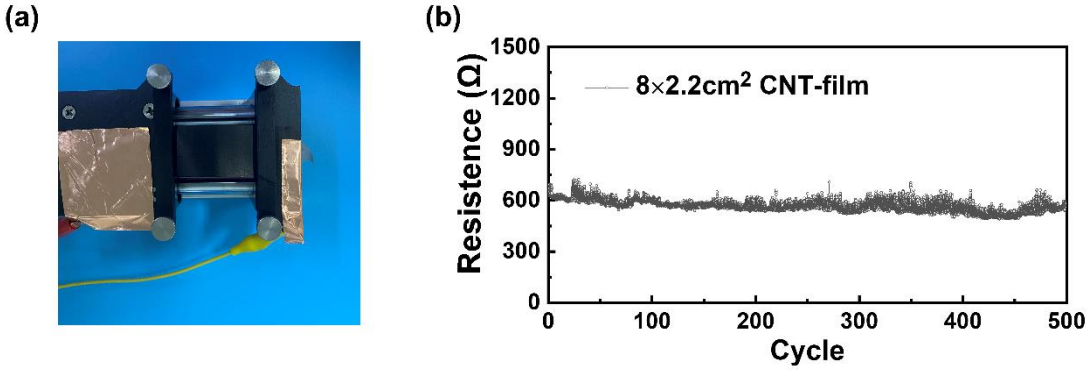

Figure S2 (a) The photograph of the post-compression CNT-film; (b) Real-time resistance values of CNT-film in a sustaining flexibility examine (0.5Hz, compressing 75% length).

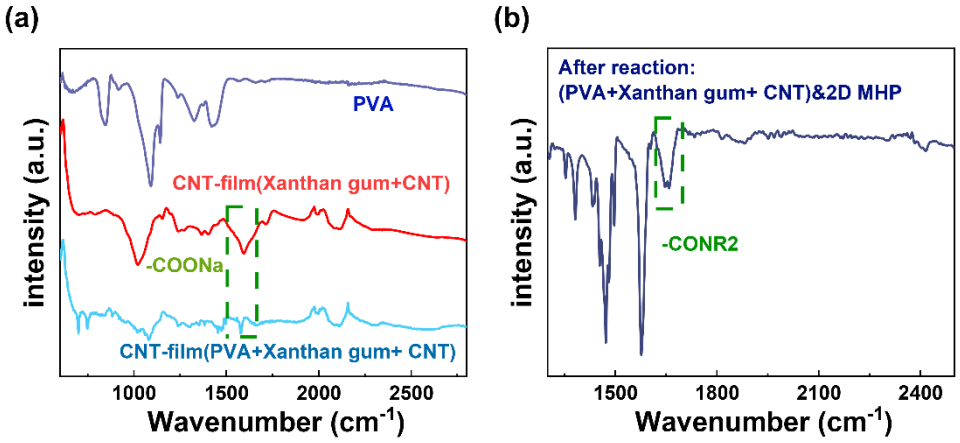

Figure S3 FTIRs of (a) CNT-film and (b) sample after wet-fusing.

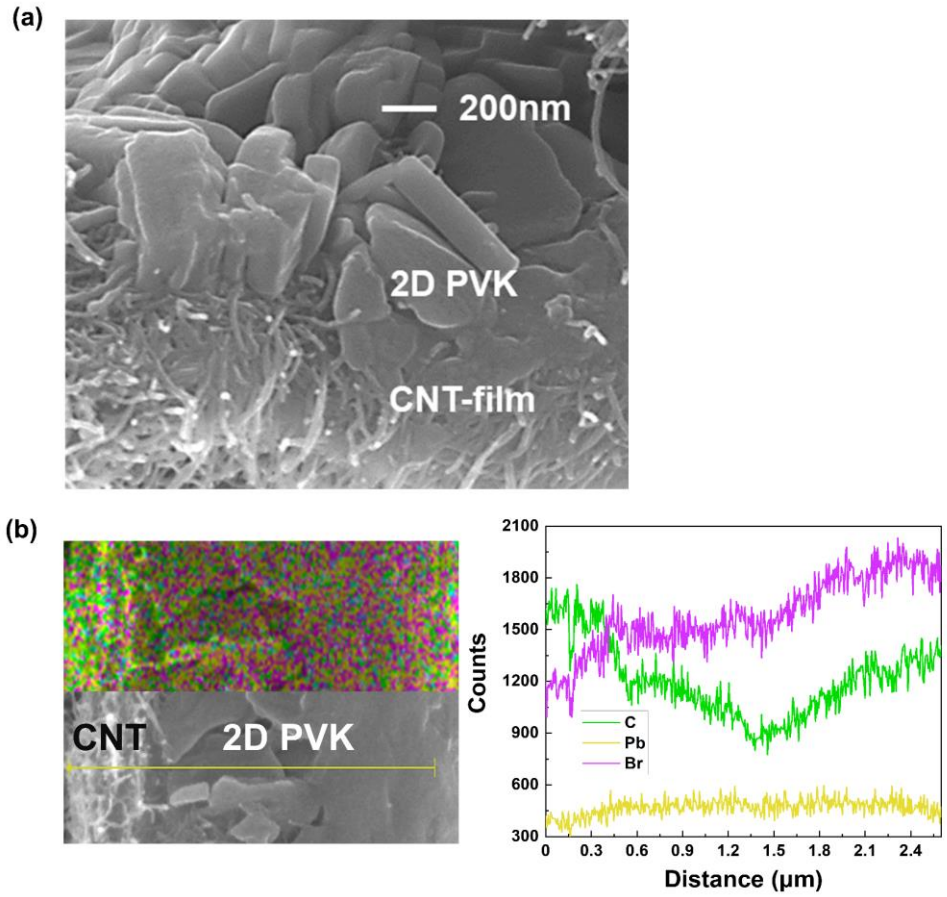

Figure S4 (a) The SEM appearance of 2D MHP growing on CNT-film. (b) Elemental analysis by EDX of the CNT/2D MHP interface showing clearly the engulfed, overlapping region between the CNTs and the perovskite.

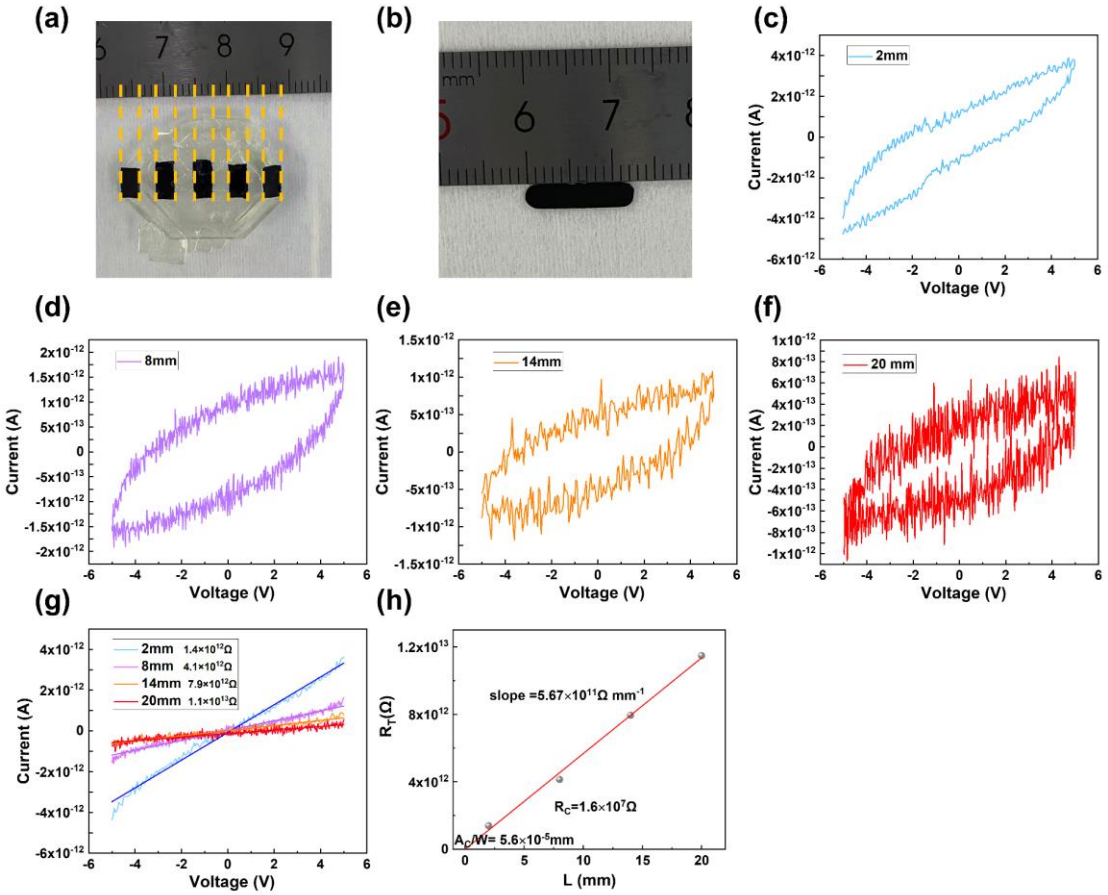

Figure S5 The photographs of (a) CNT-film wet-fusing on 2D MHPSC featuring the transfer length method (TLM) structure and (b) uniform-shape CNT-film. I-V curves of 2D MHPSC with CNT-film contact for different examining length: 2mm (c), 8mm (d), 14mm (e) and 20mm (f). (g) I-V curves of 2D MHPSC with CNT-film contact after averaging the forward sweep and reverse sweep values. (h) Determining ρ and ρ_C of 2D MHPSC with CNT-film contact by the TLM.

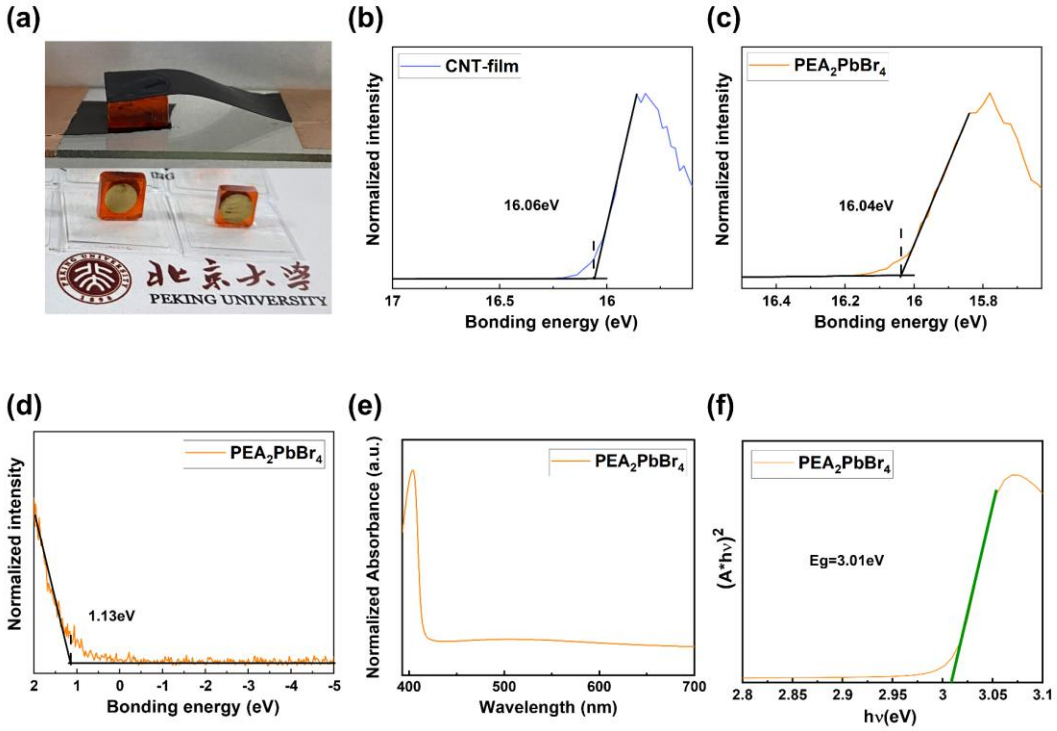

Figure S6 (a) The photographs of the prepared CNT-film/2D/3D/2D MHP/CNT-film and Au/3D/Au vertical-structure detectors. The UPS measurement results of (b) CNT-film and (c-d) 2D MHPSC. (e) Absorption spectrum of 2D MHPSC. (f) UV-vis-NIR absorption spectrum of 2D MHPSC.

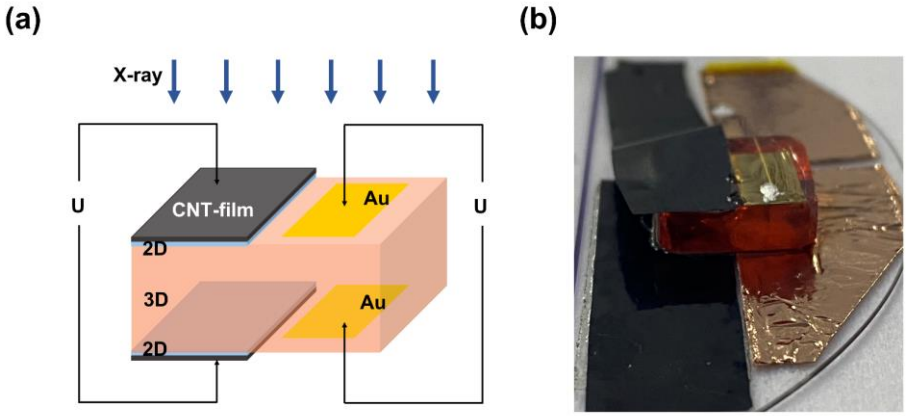

Figure S7 Schematic illustration (a) and photograph (b) of the two MSM structures, CNT-film/3D/CNT-film and Au/3D/Au, on one 5mm thick 3D MHP.

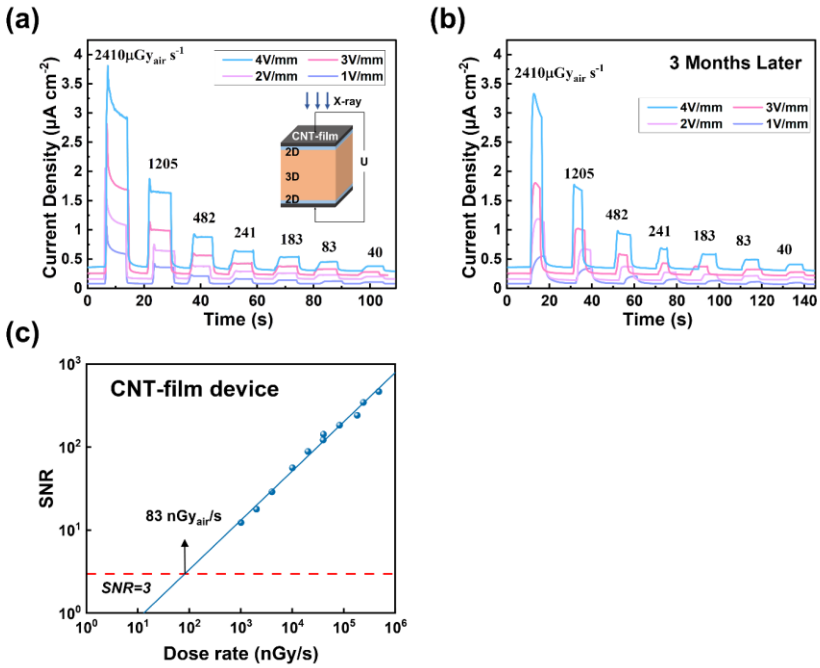

Figure S8 The J-t X-ray response current densities at different applied electric fields for a CNT-film X-ray detector (a) and for the same device after 3 months of aging (b). (c) Dose rate dependent SNR of CNT-film X-ray detector (electric field of 4 V mm^{-1}).