Electronic Supplementary Information (ESI)

Chemical decoration of $CH_3NH_3PbI_3$ perovskites with graphene oxides for photodetector applications

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Experimental Sections

Materials. All chemicals were purchased from J&K Scientific, Ltd. (China) unless indicated, and used as received.

Synthesis of $CH_3NH_3PbI_3$. In a typical synthesis, 1.135 g of PbI_2 was dissolved in 10 ml DMF with stirring at room temperature. Then, 10 mL IPA was dropwise added into the DMF solution under magnetic stirring. Then, the reaction continued to the stirring state at room temperature for 2 h. The products were separated by centrifugation at 8000 rpm for 10 min, rinsed with n-hexane by three times, and finally redispersed in IPA. Afterwards, a stoichiometric excess of CH_3NH_3I was added into the suspension under magnetic stirring at room temperature. After stirring for 3 h, the products were collected by precipitation, washed with n-hexane and IPA several times, and finally dried at 40 °C in a vacuum oven overnight.

Synthesis of rGO. The rGO was synthesized from graphene oxides according to the procedure reported by Chen et al[22]. In a typical procedure, 5 mg of graphene oxide powder was put into DMF (5 mL) solution in a 25 mL flask. Under vigorous stirring, hydrazine hydrate (4 μL) was added gradually. The reaction mixture was stirred at 80 °C for 24 h until it became black, and was then diluted with IPA (100 mL). The products were separated by centrifugation

at 10000 rpm for 10 min, raised with IPA three times, and dried at a dynamic vacuum at 40 °C for 24 h.

Synthesis of PbI_2/rGO. A typical synthesis procedure was the following: 1.135 g PbI_2 was dissolved in 10 mL DMF with stirring at room temperature. Then 5 mg rGO was fully dispersed in the DMF. After that, 10 mL IPA was dropwise added into the rGO suspension under magnetic stirring. Then, the reaction continued to the stirring state at room temperature for 2 h. The products were separated by centrifugation at 8000 rpm for 10 min, raised with n-hexane three times, and finally dried under a dynamic vacuum at 40 °C for 24 h.

Synthesis of $CH_3NH_3PbI_3$/rGO. In a typical synthesis, 0.1 g of PbI_2/rGO was first dispersed in 10 mL of IPA. Then a stoichiometric excess of CH_3NH_3I was added into the suspension under magnetic stirring at room temperature. After stirring for 3 h, the products obtained were collected by precipitation, washed with n-hexane and IPA several times, and dried at 40 °C in a vacuum oven overnight.

Characterization. X-ray diffraction (XRD) pattern data were collected with a Bruker AX D8 Advance diffractometer with nickel filtered Cu K_α radiation (λ = 1.5406 Å). Raman spectra were obtained on a Renishaw inVia Raman spectrometer using a He-Cd laser (514 nm). Transmission electron microscopy (TEM) imaging was conducted on a FEI Tecnai G2 F20 S-TWIN electron microscope operating at an accelerating voltage of 200 kV. Scanning Electron Microscopy (SEM) images were acquired on a JEOL JSM-6701F field-emission SEM at an accelerating voltage of up to 30 kV. Photoluminescence (PL) spectra were obtained on a FluoroMax@-4 spectrofluorometer (HORIBA JOBIN YVON, Inc., Edison, NJ). The 520 nm light from a 500 W Xe lamp was focused through a monochromator. Photodetector measurements were carried out on Keithley 4200SCS semiconductor characterization system.

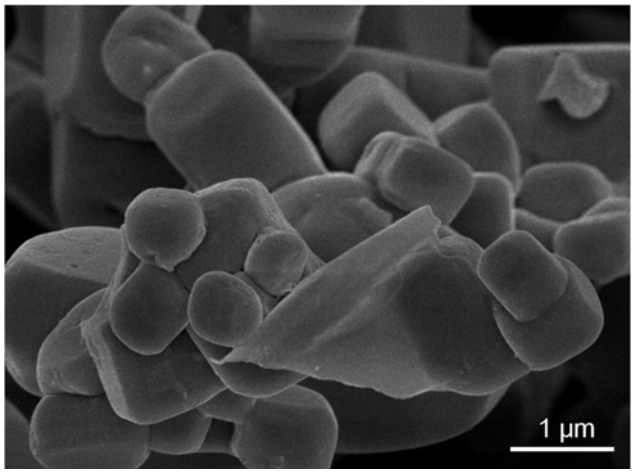

Fig. S1 SEM image of $CH_3NH_3PbI_3$/rGO hybrids.

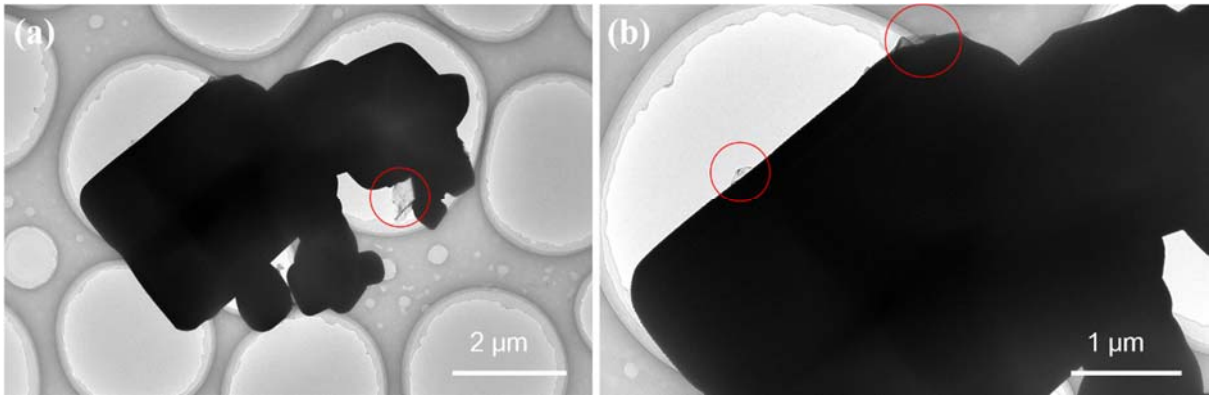

Fig. S2 TEM images of $CH_3NH_3PbI_3$/rGO hybrids at (a) low and (b) high magnifications. rGO flakes are indicated by red cycles.