Electronic Supplementary Material (ESI) for Materials Advances.

Supporting information

Oxidized Eutectic Gallium-Indium (EGaIn) Nanoparticles for Broadband Light Response in Graphene-Based Photodetector

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Section S1. The composite structure of EGaIn nanoparticles and supported graphene on the Si_3N_4 substrate.

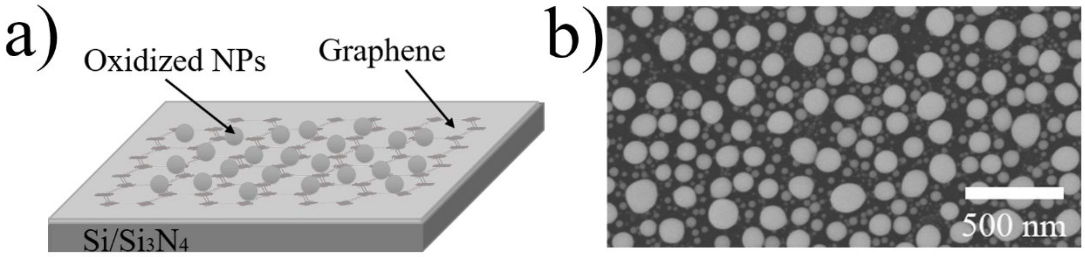

Figure S1. Characterization of oxidized EGaIn nanoparticles (NPs) on the supported graphene. (a) Schematic diagram of structure. (b) Top-view SEM images of EGaIn on the supported graphene.

Section S2. The magnified Raman spectrum of supported graphene and suspended graphene.

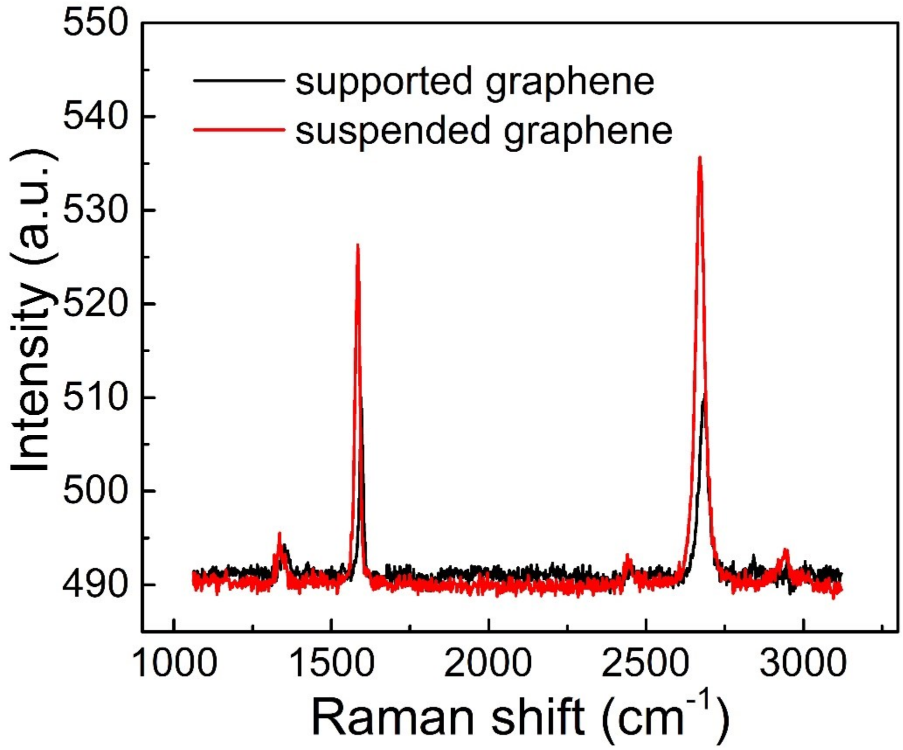

Figure S2. The Raman spectrums of supported graphene and suspended graphene.

Section S3. The gradient change of element content within the oxide layer.

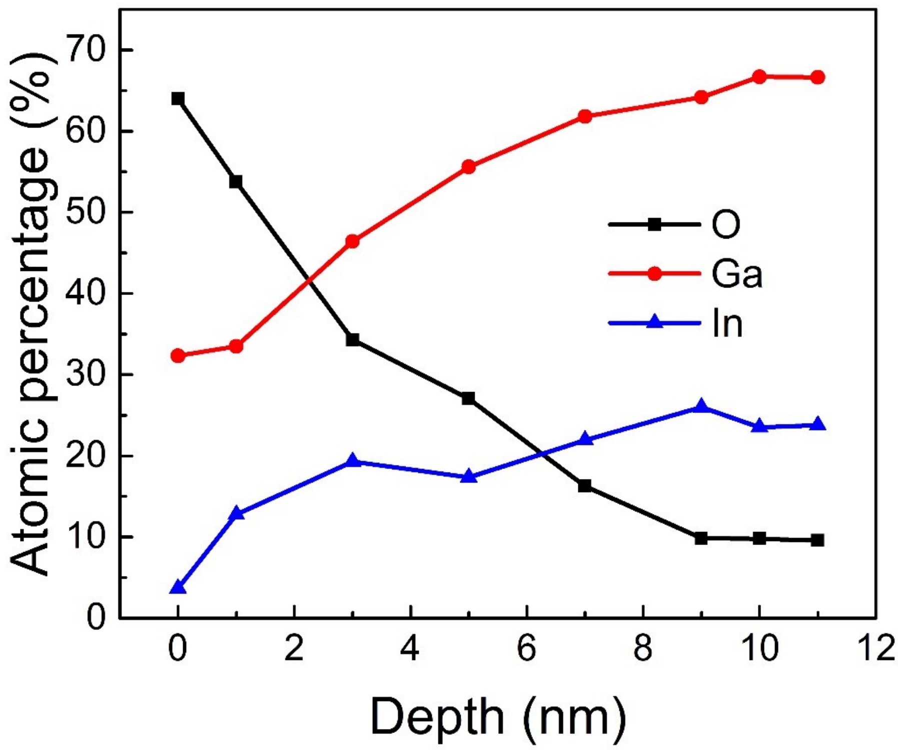

Figure S3. The change of content of elements with the increase of depth from outside to inside.

Section S4. The detailed manufacturing process of device.

The silicon wafer with 100 nm-thick Si_3N_4 isolating film is adopted as substrate. The narrow slit in the substrate is obtained by etching away isolating layer and silicon wafer, and shaped into a 1.5 mm-long, 50 μm-wide rectangle. The gold nanofilm is deposited as electrodes. With the help of spin-coated PMMA, a large graphene is suspended on the slit. Then EGaIn nanoparticles are deposited on the suspended graphene from the slit. Then the device is put in the air for one weak to achieve the nature oxidization of nanoparticles.

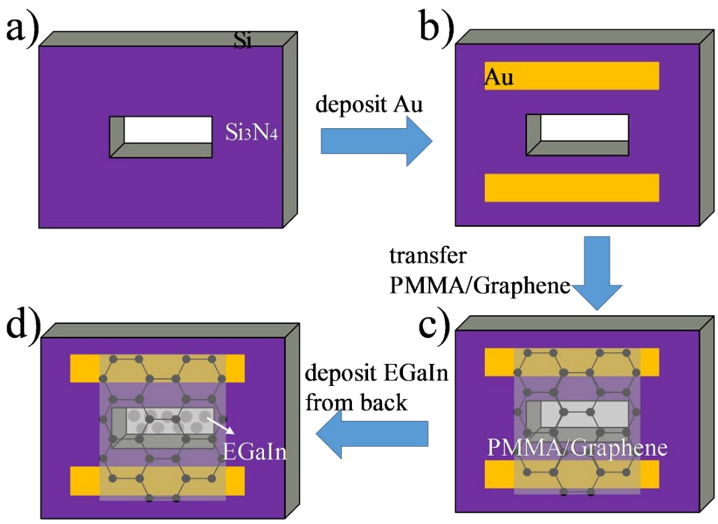

Figure S4. The schematic diagram of the device manufacturing process.

Section S5. The photoelectric response of prepared device in the vacuum.

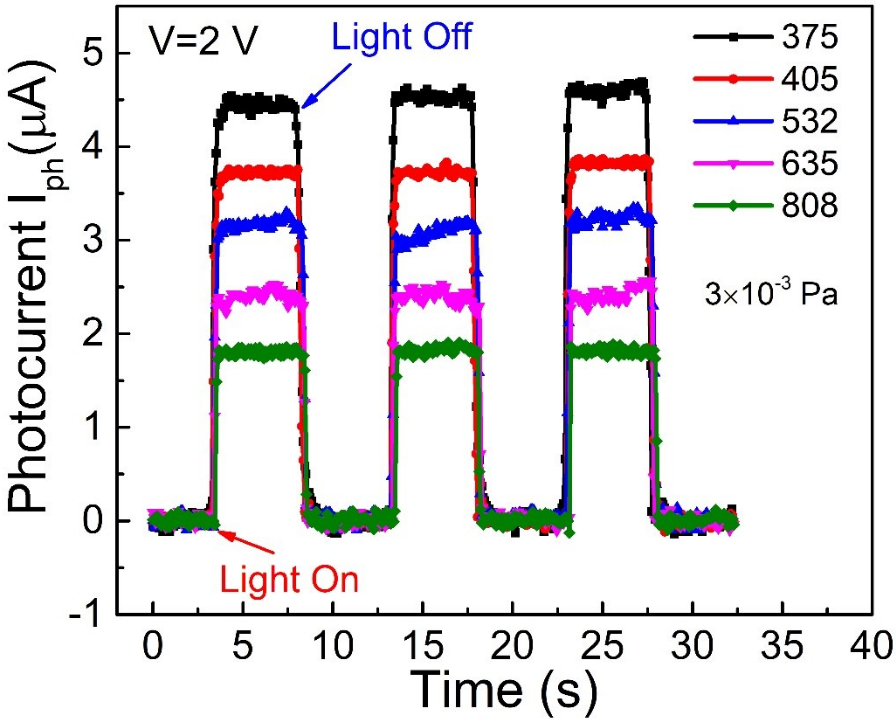

Figure S5. The photocurrent of prepared photodetector based on the composite of suspended graphene and EGaIn nanoparticles under the illumination of laser with wavelengths of 375 nm, 405 nm, 532 nm, 635 nm and 808 nm. The device is put in the vacuum with a pressure of 3×10^{-3} Pa.

Section S6. The characterization of stability in device's performance and preparation method.

In terms of device stability, we measure the photoelectric response of another device fabricated with the same method. It can be found that the photocurrent amplitude and response speed of the device is similar with that of shown in the manuscript, which exhibits the stability of device performance and preparation method.

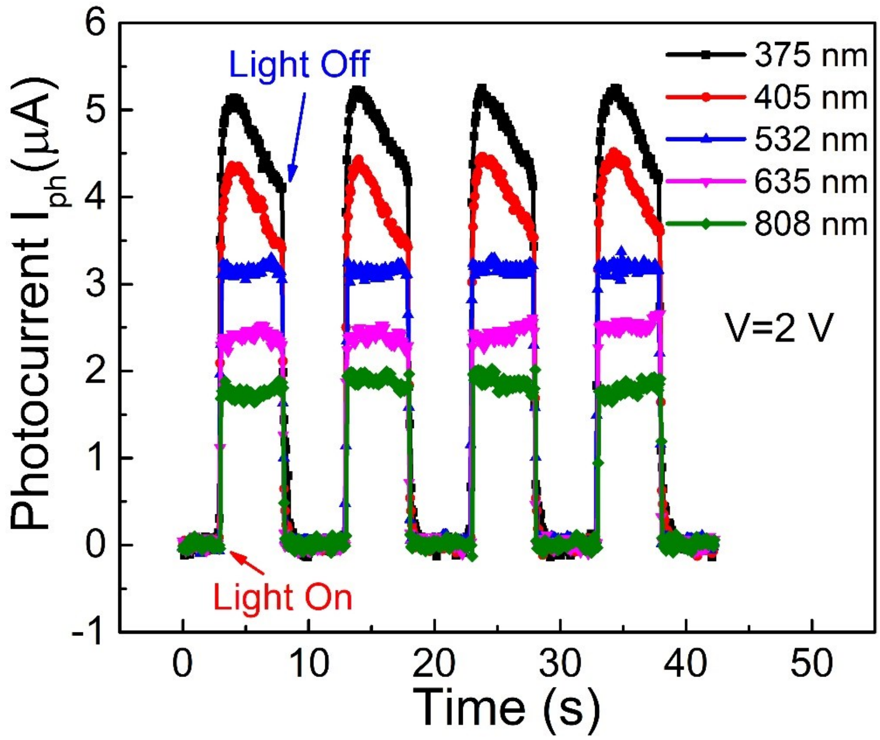

Figure S6. The photoelectrical response of another device.

Section S7. Control experiments of PMMA/graphene, oxidized EGaIn nanostructures and composite structure.

The photoelectric response of devices of graphene without EGaIn nanoparticles, graphene with EGaIn nanoparticles and EGaIn nanoparticles without graphene are measured. As shown in the Figure below, under the irradiation of 405-nm laser, a slow negative photocurrent is generated on the suspended graphene due to the desorption effect in the ambient environment; EGaIn nanostructures generate a positive photocurrent under the laser due to the existence of the oxide film as previous reported. By fabricating the composite structure of suspended PMMA/graphene and EGaIn nanostructures as shown in the manuscript, the responsivity and response speed are improved by three orders of magnitude, and wide-spectrum detection is realized with the help of the multi-level structure of indium gallium alloy

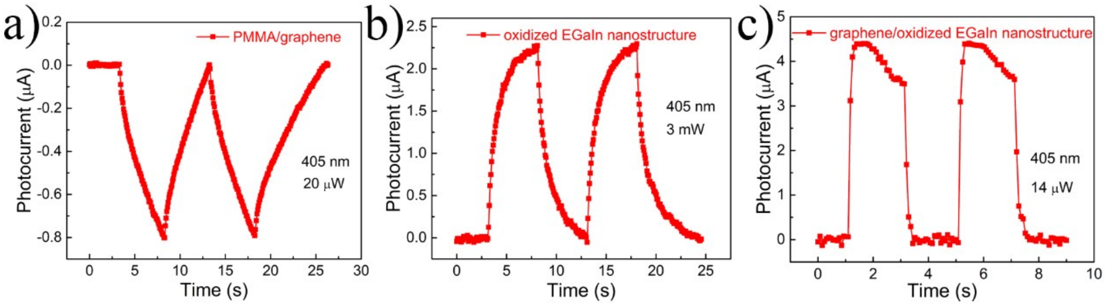

Figure S7. The photoelectrical response of devices of (a) suspended PMMA/graphene, (b) oxidized EGaIn nanostructures and (c) suspended PMMA/graphene with oxidized EGaIn nanostructures.