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Fabrication of Reduced Graphene Oxide Films on Silicon Nanowire Arrays via Photocatalytic Reduction Method and Their Applications in Infrared Light Sensing

Abstract: Graphene has become emerged as a promising material studied by many researchers due to its high electrical conductivity, high carrier mobility, low cost, and ability to absorb visible and infrared light. Chemical vapor deposition is a widely used technique for fabricating graphene on a substrate, but it is costly and environmentally unfriendly. Preparing reduced graphene oxide (rGO) films via photocatalytic reduction method is a low-cost, simple, and environmentally friendly process. The metal-rGO-metal photodetector fabricated on a silicon nanowire (SiNW) array substrate with the anti-reflection properties, is expected to exhibit excellent performance in infrared light sensing. In this study, a SiNW array, serving a photocatalyst, was prepared by metal-assisted chemical etching and then placed in a previously prepared graphene oxide suspension. Then, the rGO film was formed on the SiNW array by reducing graphene oxide in the suspension under full-spectrum light irradiation. The optical sensing results show that for 940 nm near-infrared light sensing, the response and recovery time of the devices were less than 0.017 s, and the sensitivity increased with light intensity. The SiNW array substrate exhibits 'photogate ' effect. When electron-hole pairs are generated by illumination, electrons accumulate at the top of the SiNW, which can be regarded as a negative bias gate. The negative bias gate induces the formation of an electron channel in the rGO film near its interface with SiNW array. For 2100 nm mid-infrared light sensing, the photocurrent is only caused by the in-band transport of carriers in the rGO films and electron-hole pairs in SiNW cannot be excited to induce the 'photogate' effect."

Keywords: rGO, silcon, nanowire array, photodetector, infrared light sensing

Biography: Dr. Hsun-Feng Hsu Obtained Her Ph. D. degree in 2003 from Department of Materials Science and Engineering, University of the National Tsing Hua University, Taiwan. After that, she did his postdoctoral study in Department of Materials Science and Engineering, University of the National Tsing Hua University, Taiwan. She then moved to Department of Materials Science and Engineering, University of the National Chung-Hsin University as an assistant professor. In 2010, she was promoted to Associate Professor. Her current research focuses in the fields of semiconductor nanomaterials, 2D materials, and photodetectors.