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Graphene / semiconductor nanowire hybrid optoelectronic devices

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Abstract

High-performance graphene / CdS semiconductor nanowire (SNW) Schottky junction solar cells were fabricated. Au (5 nm)/graphene combined layers were used as the Schottky contact electrodes to the NW. A promising site-controllable patterned graphene transfer method, which economizes graphene material and requires no additional etching process, was demonstrated in this work. Typical as-fabricated solar cells showed excellent photovoltaic behavior with an energy conversion efficiency up to ~1.65%. We also developed a simple and scalable graphene patterning method using electron-beam or ultraviolet lithography followed by a lift-off process. This method, with the merits of: high pattern resolution and high alignment accuracy, without additional harsh process, universal to arbitrary substrates, compatible to Si microelectronic technology, can be easily applied to array-based device applications. We also fabricated the novel graphene nanoribbon (GNR)/SNW heterojunction light-emittingdiodes (LEDs). Here in, ZnO, CdS and CdSe NWs were employed as representatives. At forward biases, the GNR/SNW heterojunction LEDs could emit light with wavelengths varying from ultraviolet (380 nm) to green (513 nm) to red (705 nm), which were determined by the band-gaps of the involved SNWs. The mechanism of light emitting for the GNR/SNW heterojunction LEDs was discussed. Our work pioneers new routes to developing diverse graphene-based nano-optoelectronic devices, which are basic components in integrated optoelectronicsystem.

Biography

Lun Dai has completed her PhD at the age of 33 years in Physics from PekingUniversity at Beijing, China in 1999. She is now Professor in School Physics, Peking University. Her research career has focusedprimarily on nano-semiconductor material, nano-electronic and nano-photonic device physics. She has published more80 SCI papers in reputed journals, including Nature, Nano Lett., Adv. Mater., JACS, ACS nano, J. Mater. Chem., Appl. Phys. Lett. etc. Total citation times for these papers are more than 1000.