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Microtube Light-Emitting Diode Arrays with Metal Cores

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Three-dimensional (3-D) semiconductor nanoarchitectures, including nano- and micro- rods, pyramids, and disks, are emerging as one of the most promising elements for future optoelectronic devices. Since these 3-D semiconductor nanoarchitectures have many interesting unconventional properties, including the use of large light-emitting surface area and semipolar/nonpolar nano- or micro-facets, numerous studies reported on novel device applications of these 3-D nanoarchitectures. In particular, 3-D nanoarchitecture devices can have noticeably different current spreading characteristics compared with conventional thin film devices, due to their elaborate 3-D geometry. Utilizing this feature in a highly controlled manner, color-tunable light-emitting diodes (LEDs) were demonstrated by controlling the spatial distribution of current density over the multifaceted GaN LEDs. Meanwhile, for the fabrication of high brightness, single color emitting LEDs or laser diodes, uniform and high density of electrical current must be injected into the entire active layers of the nanoarchitecture devices. Here, we report on a new device structure to inject uniform and high density of electrical current through the 3-D semiconductor nanoarchitecture LEDs using metal core inside microtube LEDs.

In this work, we report the fabrications and characteristics of metal-cored coaxial GaN/$In_xGa_{1-x}N$ microtube LEDs. For the fabrication of metal-cored microtube LEDs, GaN/$In_xGa_{1-x}N$/ZnO coaxial microtube LED arrays grown on an n-GaN/c-Al2O3 substrate were lifted-off from the substrate by wet chemical etching of sacrificial ZnO microtubes and SiO_2 layer. The chemically lifted-off layer of LEDs were then stamped upside down on another supporting substrates. Subsequently, Ti/Au and indium tin oxide were deposited on the inner shells of microtubes, forming n-type electrodes of the metal-cored LEDs. The device characteristics were investigated measuring electroluminescence and current-voltage characteristic curves and analyzed by computational modeling of current spreading characteristics.

Keywords: GaN, ZnO, nanoarchitecture, metal core, light-emitting diodes

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Electric-field induced si-graphene heterostructure solar cell using top gate

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Abstract : Silicon has considerably good characteristics on electron, hole mobility and its price. With 2-D sinlge-layer Graphene/n-Si heterojunction solar cell shows that in one sun condition exhibit power conversion efficiency(PCE) of 10.1%. This photovoltaic effect was achieved by applying gate voltage to the Schottky junction of the heterostructure solar cell. Energy band diagram shows that Schottky barrier between Si and graphene can be adjust by the external electric field. because of the fermi level of the graphene can be changed by external gate voltage, we can control the Schottkky barrier of the heterostructure solar cell. The ratio between generated power of solar cell and consumption electrical power is remarkable. Since we use the graphene as the top gate electrode, most of the sun light can penetrate into the active area.

Keywords: Graphene, silicon, schottky juntion, solar cell