Title: Low-cost nanofabrication of nanorod InGaN/GaN multiple-quantum-wells light-emitting diodes

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Abstract: In this study, we will demonstrate an economic method to fabricate InGaN/GaN nanorod light-emitting diodes (LED). The method is based on top-down approach where GaN layers are etched by combination of dry inductive-coupled plasma (ICP) and wet etches. The nanopatterns are either accomplished by low-cost Nanosphere Lithography or Nanospherical-Lens Lithography. The top contact of this rod-shape and p-side up LED is accomplished by either a thin layer of graphene or metal nanohole membranes. Optical and electrical characterizations of these LEDs will also be presented. We believe the fabricated nanorod LED will demonstrate new properties that will be useful for current LED industries.

Extended Abstract: Modern light-emitting diodes (LEDs) have been improved to a record-high efficiency with an unbelievable pace. However, to further improve the efficiency, newer concepts are very crucial. Nanophotonics provides new and novel ways to manipulate the emitted photonics, which has been proved to be able to improve the device’s performance. The expensive fabrication cost to fabricate the necessary nanostructures proved to be the bottleneck for the penetration of these nanostructures into current industrial applications of LEDs.

In this study, we will propose a low-cost nanofabrication method to fabricate nanorod LED. The method is based on top-down approach where GaN layers are etched by combination of dry inductive-coupled plasma (ICP) and wet etches. The etch mask will be patterned by low-cost Nanosphere Lithography (NSL) or Nanospherical-Lens Lithography (NLL) that have been developed in our group for the last few years. The most difficult steps for this research is to fabricate the top contact to the nanorods. We proposed to use either a thin layer of graphene or metal nanohole membranes fabricated by NLL. Optical and electrical characterizations of these LEDs will also be presented. We believe the fabricated nanorod LED will demonstrate new properties that will be trigger new design of LED for the future LED industries.