III-V semiconductor nanowire/graphene structures and photonic devices

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Abstract

Heterostructured III-V semiconductor nanowires have attracted considerable attention in recent years due to their potential in future nano-electronic and nano-photonic device applications. The III-V nanowire project at NTNU today involves the epitaxial growth, structural and nano-optoelectrical characterization, as well as processing of devices. In this talk, I will give some highlights of our work since the first GaAs nanowires were grown in our lab in 2006, including single-mode lasing in a single GaAsSb nanowire superlattice at room temperature.

I will then focus on our work on epitaxial growth of III-V semiconductor nanowires on graphene [1-3]. The epitaxial growth of semiconductor nanostructures on graphene is very appealing for photonic device applications since graphene can function not only as a replacement of the semiconductor substrate but in addition as a transparent and flexible electrode for e.g. solar cells and LEDs. For deep ultraviolet AlGaN based LEDs, in need for various disinfection and sterilization purposes, the concept offers a real advantage over present thin film based technology. Such UV LEDs are today very expensive and inefficient due to the lack of a good transparent electrode (ITO is absorbing in deep UV), the high dislocation density in the active thin film layers, low light extraction efficiency, and the use of very expensive semiconductor substrates or buffer layers of AlN. Both NTNU (MBE) and our spin-off CrayoNano (MOCVD) are now developing UV LEDs based on the growth of AlGaN nanostructures on graphene, which potentially can overcome these problems. As a proof-of principle of this concept a first AlGaN nanowire/graphene flip-chip UV LED device made by NTNU, will be shown at the end of my talk.

References

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