GaAs-Ga(As,Bi) Core-Shell Nanowires – Structural and Optical Properties

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Alloying GaAs with Bi results in a ternary alloy with interesting optical properties, due to the important band-gap reduction and enhancement of the spin-orbit splitting in Ga(As,Bi). Both features make this ternary alloy interesting for optoelectronic applications in near-infrared energy range, and suitable for solar cell applications. The maximum Bi content in uniform Ga(As,Bi) compound reported so far reaches about 10%. Attempts to obtain higher composition of Ga(As,Bi) solid solution lead to Bi segregation either at the growth front or inside the volume of the growing crystal [1, 2]. We have investigated Bi incorporation into thin Ga(As,Bi) shells deposited around GaAs nanowire (NW) cores. The NWs have been grown by molecular beam epitaxy (MBE) using Au-catalysed growth mode. First the GaAs core NWs were grown at optimum conditions, then Ga(As,Bi) NW shells were deposited at low temperatures (300 – 350 ^{o}C) and close-to-stoichiometric As/Ga flux ratio. The NWs were grown in two distinct crystallographic structures – zinc-blende (ZB), typical for GaAs bulk crystals and layers, and hexagonal wurtizte (WZ) structure, possible to obtain in NWs grown in suitable conditions. Bi incorporation limits into ZB and WZ GaAs will be compared. For the NW Ga(As,Bi) NW cores grown at the highest As/Bi flux ratio we have observed segregation of Bi nanodroplets at the NW side-walls (see Fig. 1). These nanodroplets act as the catalyst for the growth of NW branches, perpendicular to main GaAs NW truncs.

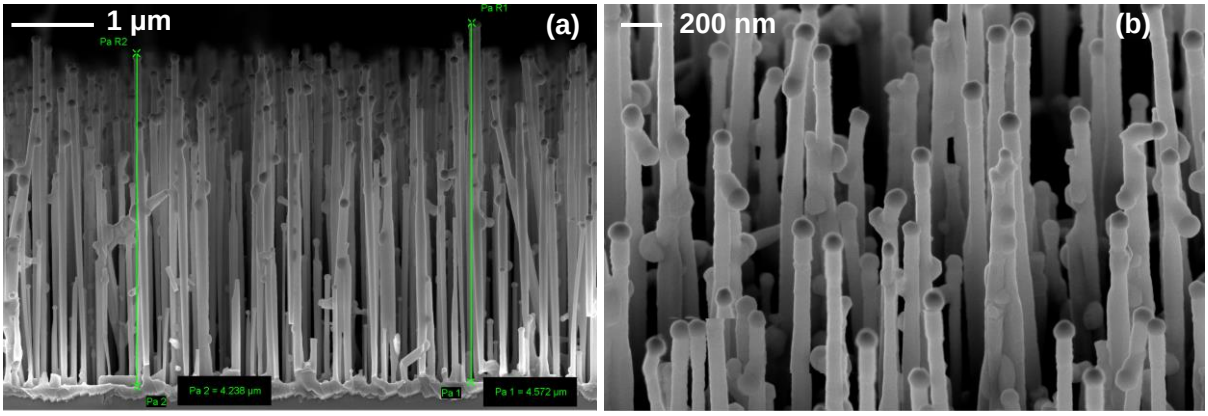

Fig.1. SEM images of GaAs-Ga(As,Bi) core shell NWs grown above Bi surface segregation threshold. (a) – cross-sectional view, (b) 45^{o} view.

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