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Wurtzite phase control of self-assisted GaAs nanowires grown by molecular beam epitaxy

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III-V semiconductor nanowires (NWs) obtained by the vapor-liquid-solid (VLS) mechanism exhibit a zinc-blende (ZB) or a wurtzite (WZ) structure [1] depending on the growth conditions, and more particularly on the amount of III and V element fluxes [2]. Controlling precisely the growth of the crystal phases of self-assisted GaAs NWs by molecular beam epitaxy (MBE) would be an important achievement for device applications [3]. Nevertheless, the optimized growth of WZ segments in nanowire geometry is still in its infancy, and major achievements have been reported only very recently [4-6].

In this work, we used an analytical growth model to show the existence of a stationary regime allowing the formation of a pure WZ phase, by a precise tuning of the V/III ratio. A slight change of the As flux indeed induces a modification of the catalyst droplet wetting angle in a desired range of values. The combination of an *in situ* reflection high energy electron diffraction (RHEED) evolution with high-resolution scanning transmission electron microscopy (STEM) and dark field TEM, as well as photoluminescence analysis confirmed the successful control of a micron-long pure WZ segment, obtained by MBE growth of self-assisted GaAs NWs [7].

[1] F. Glas, *et al*, *Physical Review Letters*, **99** (2007), 146101.
[2] F. Panciera, *et al*, *Nano Letters*, **20** (2020), 1669-1675.
[3] E. M. T. Fadaly, *et al*, *Nature*, **580** (2020), 205-209.
[4] T. Dursap, *et al*, *Nanoscale Adv.*, **2** (2020), 2127-2134.
[5] M. M. Jansen, *et al*, *ACS Appl. Nano Mater.*, **3**, **11** (2020), 11037-11047.
[6] T. Dursap, *et al*, *Nanotechnology*, **32** (2021), 155602.

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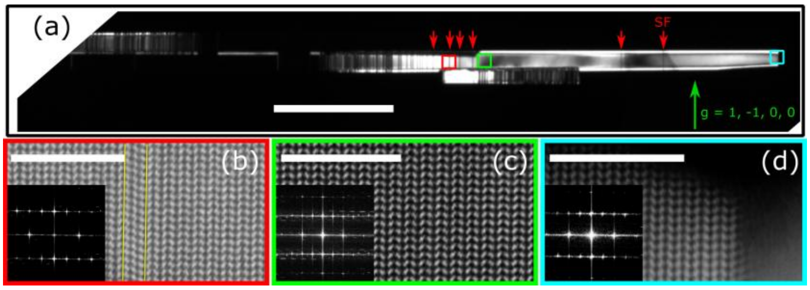

Figure 1: (a) Dark-field TEM image of the extended WZ segment. The red arrows indicate the stacking faults visible in the WZ segment. Scale bar is 500 nm. High-resolution STEM-HAADF images showing (b) the beginning or the extended WZ segment with a 3 MLs long ZB segment, (c) a portion of the extended WE segment and (d) the end of the extended WZ segment with the Ga droplet/NW interface. Scale bars on (b)-(d) are 5 nm.