Arrays of 3D super-structures on crystal phase engineered III-V nanowires

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Crystal phase control in III-V nanowires is a promising approach to fabricate quantum dots (QDs)-in-NW[1,2] structures to inspect fundamental quantum effects[2,3]. However, the contours of the growth parameter window resulting in crystal phase control on GaAs nanowires over large area patterns remain undefined. Herein, we present a comprehensive growth map (based on substrate temperature and V/III ratio) that unambiguously establish the parameter space window resulting in the growth of crystal phase controlled GaAs nanowires (Figure 1). The applicability of this method is demonstrated by the successful realization of axial crystal phase controlled structures (Figures 1b and c) and 3D architectures involving facet dependent core/shell GaAs/InAs growth. Substrate patterning was performed by means of Displacement Talbot lithography and the growths by means of Au assisted Metal-Organic Vapor Phase Epitaxy following the Vapor-Liquid-Solid (VLS) growth mechanism. This work should open the door for new nanoscale crystal phase engineered materials over a range of compound semiconductors for improved device performance.

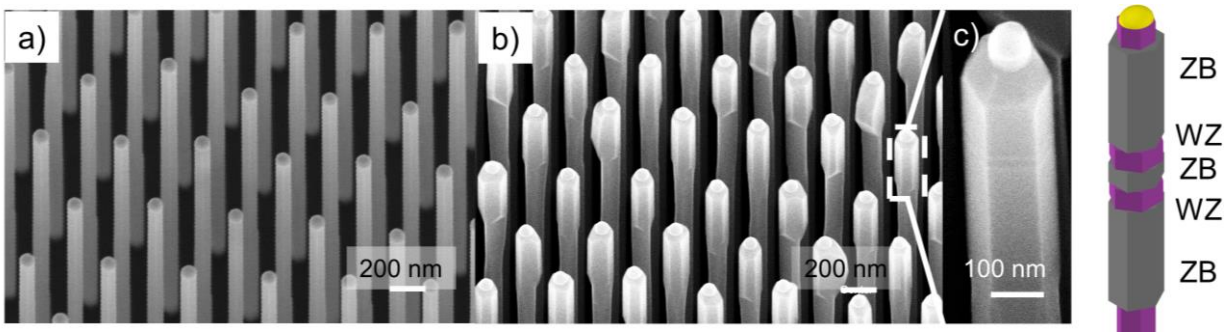

Figure 1 *shows 30º tilted scanning electron micrograph of a) an array of wurtzite GaAs nanowires, b) an array of GaAs nanowires with axial crystal phase control, c) zoom over one of the structures, inset shows a sketch of the crystal phase encoding, where ZB and WZ stand for zinc-blende and wurtzite, respectively.*

References

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