New Insights into the Origins of Sb-Induced Effects on Self-Catalyzed GaAsSb Nanowire Arrays - DTU Orbit (08/11/2017)

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Tertiary semiconductor nanowire arrays enable scalable fabrication of nano-optoelectronic devices with tunable bandgap. However, the lack of insight into the effects of the incorporation of V_y element results in lack of control on the growth of ternary III-$V_{1-y}V_y$ nanowires and hinders the development of high-performance nanowire devices based on such ternaries. Here, we report on the origins of Sb-induced effects affecting the morphology and crystal structure of self-catalyzed GaAsSb nanowire arrays. The, nanowire growth by molecular beam epitaxy is changed both kinetically and thermodynamically by the introduction of Sb. An anomalous decrease of the axial growth rate with increased Sb_2 flux is found to be due to both the indirect kinetic influence via the Ga adatom diffusion induced catalyst geometry evolution and the direct composition modulation. From the fundamental growth analyses and the crystal phase evolution mechanism proposed in this Letter, the phase transition/stability in catalyst-assisted ternary III-V-V nanowire growth can be well explained. Wavelength tunability with good homogeneity of the optical emission from the self-catalyzed GaAsSb nanowire arrays with high crystal phase purity is demonstrated by only adjusting the Sb_2 flux.

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