Lazarevicite-type short-range ordering in ternary III-V nanowires

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Stabilizing ordering instead of randomness in alloy semiconductor materials is a powerful means to change their physical properties. We used scanning tunneling (STM) and transmission electron microscopy to reveal the existence of an unrecognized ordering in ternary III-V materials. The lazarevicite short-range order (SRO), found in the shell of $InAs_{1-x}Sb_x$ nanowires (NW) [cf. Fig. 1 a-d], is driven by strong Sb-Sb repulsion along ⟨110⟩ atomic chains during Sb incorporation on unreconstructed {110} sidewalls. A preferred formation of lazarevicite SRO under group-III-rich growing conditions is found as shown by the pair correlation function c(x,y) in Fig. 1e and supported by our DFT calculations. Based on these observations, we present a growth model that offers the prospect to broaden the limited classes of ordered structures occurring in III-V semiconductor alloys. [1]

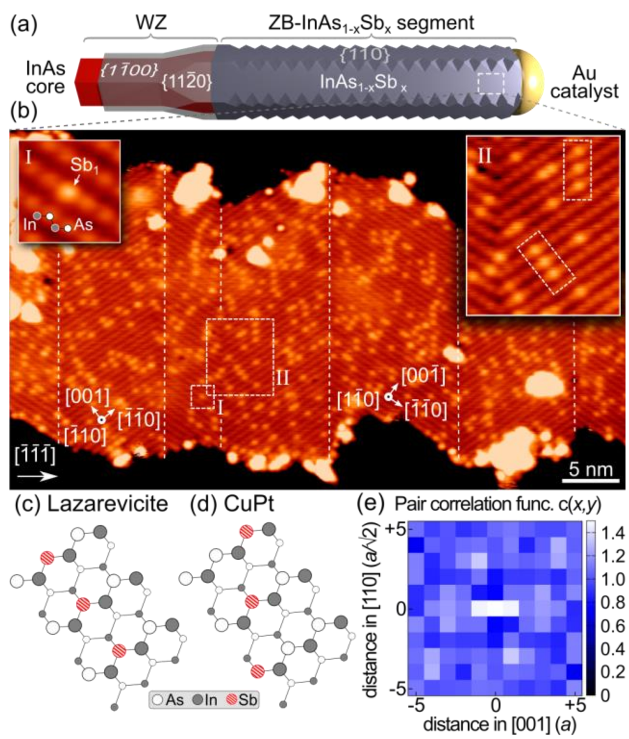

Figure 1: a) Schematic of a $InAs_{0.9}Sb_{0.1}$/InAs NW b) Atomically resolved filled state STM image of the sidewall surface. Inset I) magnification of area labeled I, showing one Sb_{As} atom in the surface layer. Inset II) magnification of area labeled II, showing lazarevicite- and CuPt-type SRO. c) and d) illustrate the respective atomic models. e) Pair correlation function of the Sb_{As} distribution in (b).

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