Poster Presentation

MS48.P10

X-ray investigation of polytype distribution in InAs nanowires during MBE growth

U. Pietsch[1], A. Biermanns[1], E. Dimakis[2], L. Geelhaar[2], A. Davydok[1], M. Takahashi[3], T. Sasaki[3]

[1]University of Siegen, Department of Physics, Siegen, Germany, [2]Paul-Drude-Institut für Festkörperelektronik, Berlin, Germany, [3]Japan Atomic Energy Agency, Hyogo, Japan

The monolithic integration of III-V semiconductors with Si is the ideal way to combine the superior optoelectronic properties of the compound semiconductors with the mature Si technology. This integration can be realized by growing epitaxially dislocation-free III-V NWs on Si substrates either in the vapor-liquid-solid (VLS) or in the vapor-solid (VS) mode associated with the presence or absence, respectively, of group-III liquid droplets on the NW tips [1]. In this work, we investigate the correlation between the growth mode and the forming polytypes in InAs NWs grown on Si(111). The growth was performed in the molecular beam epitaxy chamber of beamline 11XU at Spring8 [2], while the structural dynamics was probed by in situ x-ray diffraction. Specifically, the time evolution of the formation of wurtzite (WZ) and zincblende (ZB) polytypes was monitored during the NW growth. Despite the As-rich growth conditions, a spontaneous build-up of liquid In on Si was found to be present in the nucleation phase, where the InAs nuclei mainly grow in the WZ phase with low number of stacking faults. Shortly after the nucleation, the liquid In is consumed by the excessive As, and the growth continues in the VS mode with an increasing density of stacking faults forming in the NW crystal. The time evolution of the liquid Indium signal (Fig. (a)) correlates well with the time evolution of wurzite growth rate (Fig (b)). The latter saturates at a time where the liquid indium disappers, i.e. where the VLS changes into the VS mode, whereas the zinc-blende polytypes grow almost continuous in both VLS and VS growth mode. The dynamics of stacking faults density was determined quantitatively by ex-situ X-ray diffraction measuring thestacking fault induced increase of the peak width of wurtzite reflections at InAs nanowire samples of different length ; i.e. growth time [3].

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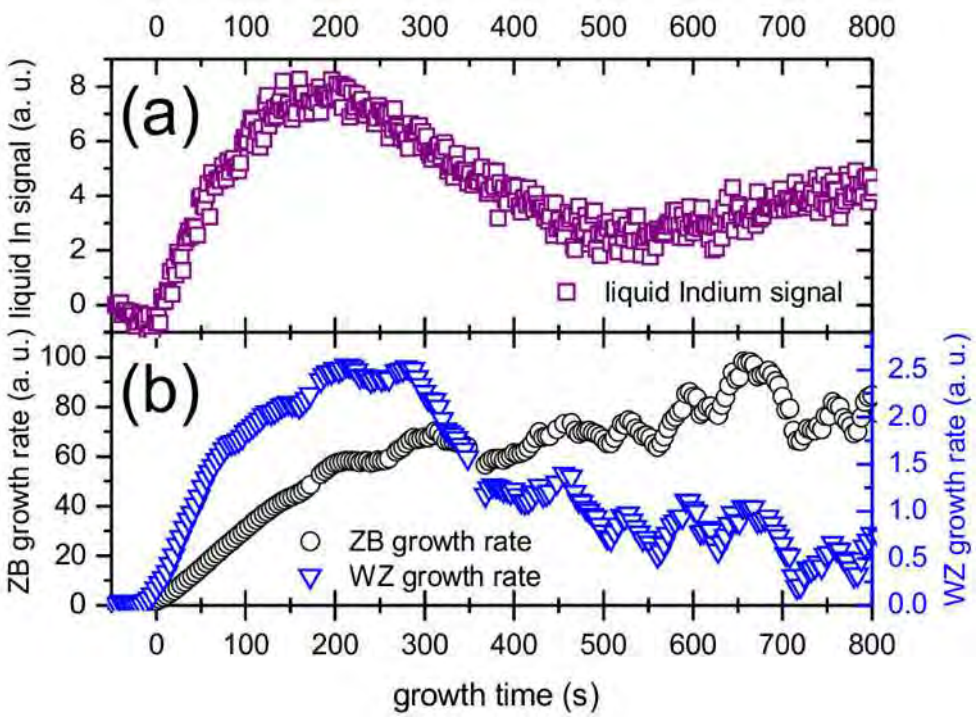

Keywords: in-situ MBE growth, InAs nanowires, polytypes