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MBE growth of InAs nanowires on Si

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InAs nanowires grown on Si are promising and have attracted a lot of attention since its potential in applications to electronic and optoelectronic devices on Si platform have been deciphered. The small contact area of the nanowires is able to mitigate the large lattice and thermal mismatches in between InAs and Si. However, the orientation control for InAs nanowires on Si is an issue for the growth. Basically, the axial direction of InAs nanowire is along the predominate <111>B family. The non-polarity of Si further complicates the issue and allows four <111>B directions for InAs nanowires on either (001) or (111) Si substrate. To control the direction of InAs nanowires on (001) Si, we propose a two-step growth method utilizing the shadowing effect in MBE growth to grow InAs nanowires from a SiO_2/Si nanotrench structure. In the first step, we aligned the In beam with the longitudinal axis of the trench. Due to a shadowing effect resulting from one trench wall, InAs nucleated on the opposite trench end. In the second step, the growth proceeded with substrate rotation to elongate the nanowire. Because the trench was along [-110], the narrow trench width effectively blocked the growth of InAs nanowires perpendicular to the long axis of the trench. In this manner, we were able to control the growth direction. Up to 94% of the nanowires were along the desirable direction. Cross-sectional TEM was used to investigate the structural properties of the nanowires as well as the growth mechanism of nanowires and clusters in the trenches. We found that the nanowires developed from Si residue at the trench end with low misfit dislocation density. While the cluster developed at the center of the trench has high misfit dislocation density at InAs/Si interface. Details of the growth mechanism will be presented.

Biography

Hao-Hsiung Lin received his PhD degree from National Taiwan University in 1985. He has been working as a Professor with the Department of Electrical Engineering at National Taiwan University since 1992. His research interests are on the MBE growth of dilute nitrides, mid-infrared semiconductors and nano-hetero-epitaxy of compound semiconductors. He has published more than 170 papers in reputed journals. He is a Member of the Chinese Institute of Engineers and a Senior Member of IEEE.

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