Growth of Pure Wurtzite InGaAs Nanowires for Photovoltaic and Energy Harvesting Applications

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Vertically aligned and highly densified InGaAs nanowires were grown on Si (111) substrates by Au-assisted molecular beam epitaxy, and antireflection characteristics of the InGaAs nanowires were characterized. The bandgap of InGaAs NWs was tuned by varying the In to Ga ratio; the compositions of Ga and In were controlled to adjust a bandgap to ~1.0 eV. The obtained nanowires were vertically aligned with a diameter of ~20 nm near the top and ~44 nm at the bottom, a slightly tapered morphology. This morphological shape can be formed because of the different surface diffusivities and affinities of In and Ga to the Au catalyst. By controlling the deposition conditions, InGaAs nanowires with no significant stacking defects, kinking, and bending were grown successfully on Si (111) substrates. High-resolution transmission electron microscopy studies showed that the InGaAs nanowires were grown with a pure wurtzite single crystalline structure with a maximum length of ~18 µm. Photo-reflectometry and spectroscopic ellipsometry measurements showed a significant reduction in the reflectance, less than ~5% for normal incidence in the wavelength range of 200−1700 nm and considerable reduction at incident angles of 30−70°, demonstrating the antireflection properties of the InGaAs nanowires. Furthermore, piezoelectric properties were observed in all the areas where InGaAs nanowires were grown for a contact area of 2 µm × 2 µm, as the growth direction was along the polar *c*-axis (<111> direction) of the hexagonal structure.

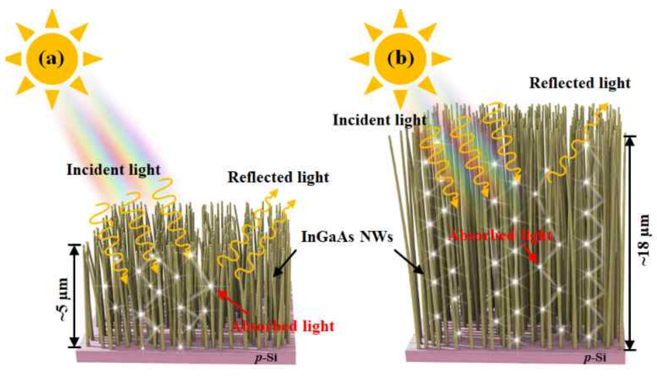

Figure. Schematic of reflectance at normal incidence depending on the length of the nanowires at t_g = (a) 1 and (b) 3 h.

Reference

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