Vertical "III–V" V-Shaped Nanomembranes Epitaxially Grown on a Patterned Si[001] Substrate and Their Enhanced Light Scattering

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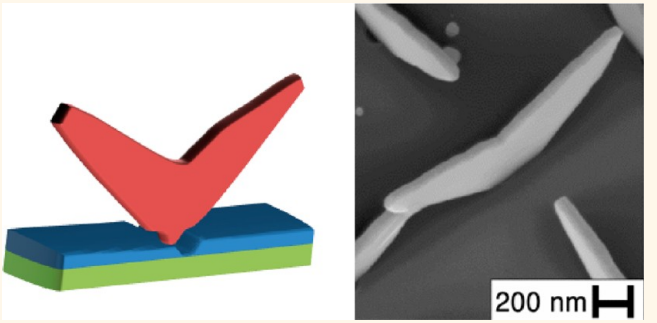
ABSTRACT We report on a new form of III–V compound semiconductor nanostructures growing epitaxially as vertical V-shaped nanomembranes on Si(001) and study their light-scattering properties. Precise position control of the InAs nanostructures in regular arrays is demonstrated by bottom-up synthesis using molecular beam epitaxy in nanoscale apertures on a SiO_2 mask. The InAs V-shaped nanomembranes are found to originate from the two opposite facets of a rectangular pyramidal island nucleus and extend along two opposite ⟨111⟩ B directions, forming flat {110} walls. Dark-field scattering experiments, in combination with light-scattering theory, show the presence of distinctive shape-dependent optical resonances significantly enhancing the local intensity of incident electromagnetic fields over tunable spectral regions. These new nanostructures could have interesting potential in nanosensors, infrared light emitters, and nonlinear optical elements.



KEYWORDS: III–V nanostructures · nanomembranes · V-shape · nucleation · light scattering