

Figure 1. All-MBE GaP regrowth. (a) (left) Planview and (right) XS SEM showing selective GaP growth after (left) 250 nm and (right) 1.575 μm GaP PSE at a rate of 0.23 $\mu\text{m}/\text{hr}$ (Ga open 15 s, closed 15 s) was performed over ~ 30 nm tall SiO_2 gratings; no polycrystalline material formed on the mask under these growth conditions and enhanced lateral growth for gratings along $[010]$ was observed. (b) After lateral epitaxial overgrowth of GaP by PSE, planar coalescence by 3 μm continuous epitaxial growth restoring the (100) GaP surface at a rate of 0.35 $\mu\text{m}/\text{hr}$.

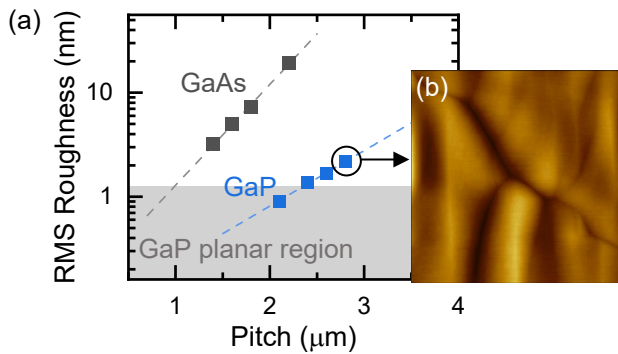


Figure 2. (a) RMS roughness measurements of the GaP planar coalescence over SiO_2 gratings along the $[010]$ direction compared to its GaAs counterpart show a decreased surface roughness with respect to grating pitch. (b) Atomic force microscopy (AFM) of a 2.8 μm pitch SiO_2 grating show that an epitaxially smooth surface was restored after coalescence. The AFM scan is $10 \times 10 \mu\text{m}^2$ and its height range is ± 9 nm.

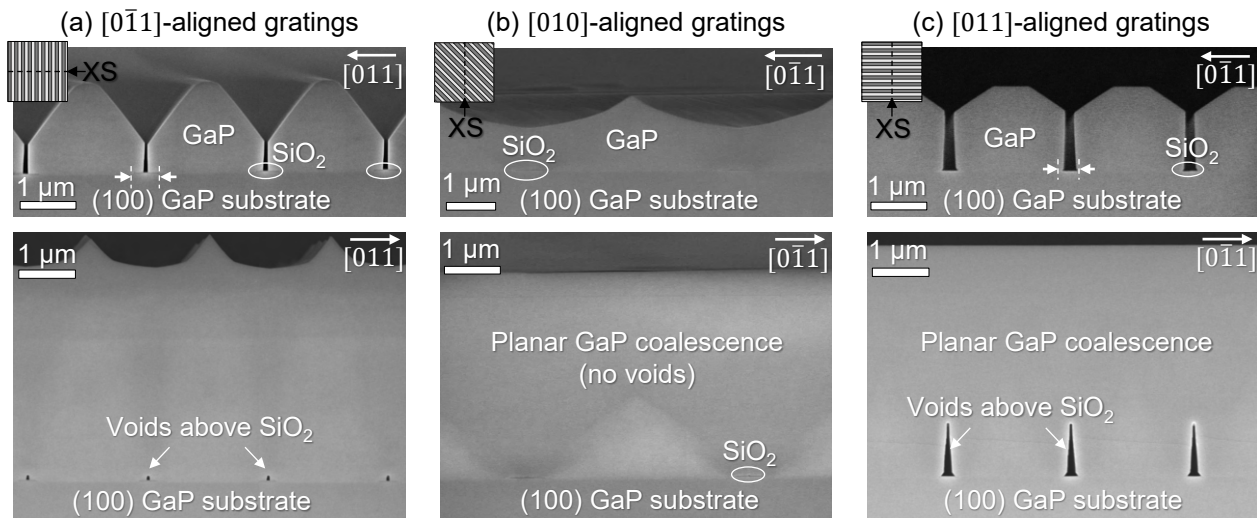


Figure 3. Cross-sectional SEM images of GaP (top) lateral epitaxial overgrowth and (bottom) coalescence for (a) $[0\bar{1}1]$ -, (b) $[010]$ -, (c) $[011]$ -aligned gratings showing produce growth morphology. Unlike the (b) $[010]$ grating orientation, a limited lateral growth rate during PSE and the formation of voids after GaP coalescence above the SiO_2 gratings aligned to the (a) $[0\bar{1}1]$ and (c) $[011]$ directions was observed. Restoration of the (100) GaP planar surface was achieved for the (b) $[010]$ -, (c) $[011]$ -aligned gratings, whereas the $[0\bar{1}1]$ -aligned structures struggled to planarize resulting in corrugated surface with 590 nm tall ridges located above the III-V window regions.