

Supporting information

Plasma-free Metal-assisted Chemical Etching Producing Three-dimensional Gallium Nitride Structures

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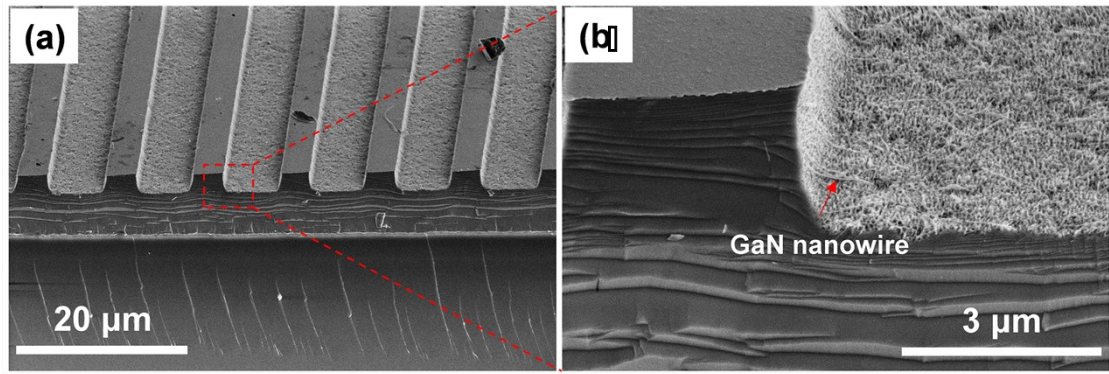


Figure S1. (a) 45°tilted SEM images of GaN trench array taken at cross-section. (b) Zoom-in SEM images corresponding to red outlined region of (a).

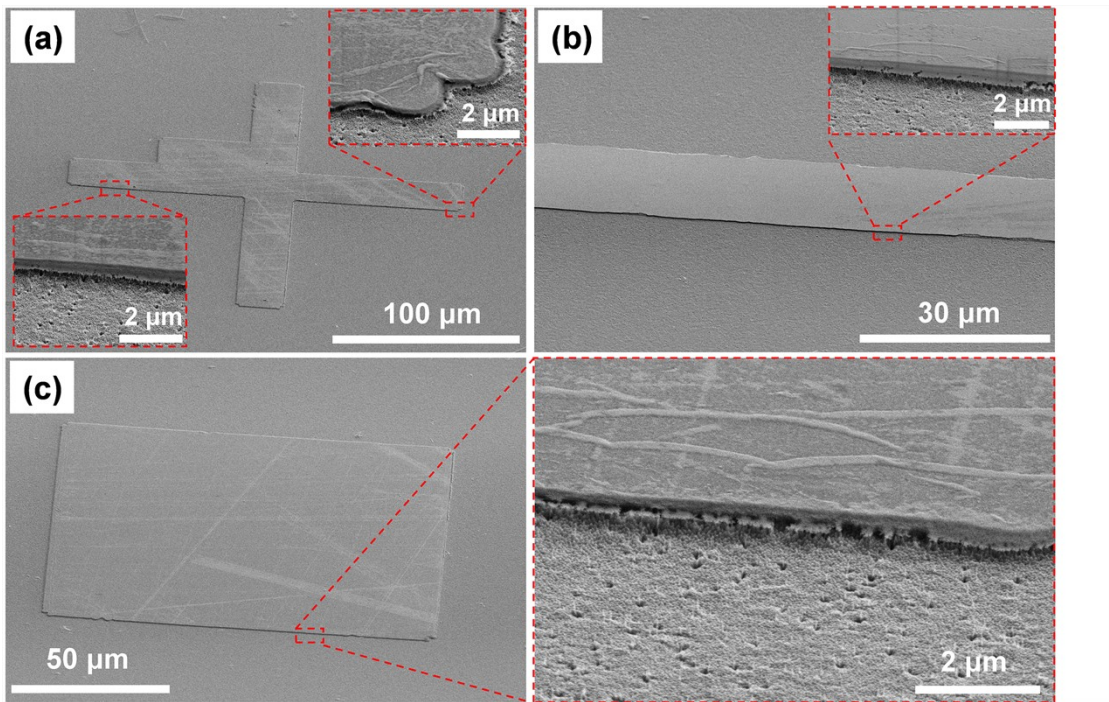


Figure S2. 45°tilted SEM images of vertical GaN structures after 30 min MacEtch with Pt patterns of (a) cross, (b) isolated strip, and (c) rectangular pad. Insets show the zoom-in images at outlined areas.

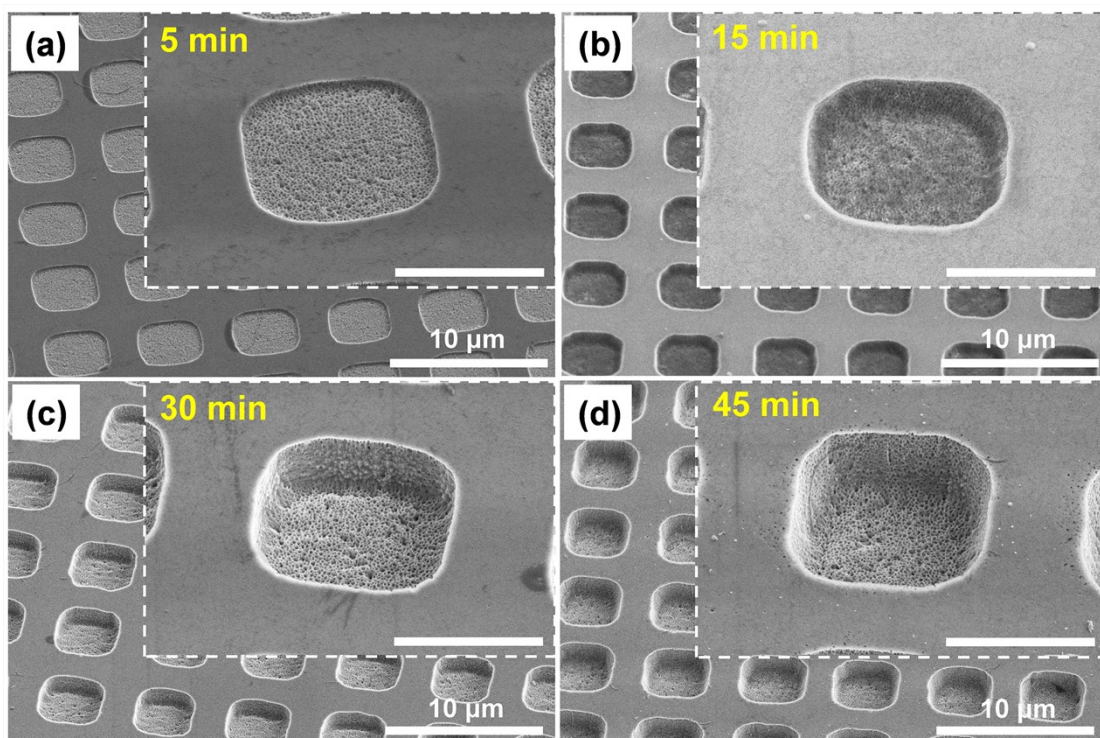


Figure S3. 45° tilted SEM images of GaN hole array obtained from MacEtch of (a) 5 min, (b) 15 min, (c) 30 min and (d) 45 min. Insets show the individual hole with a scale bar of 3 μm.

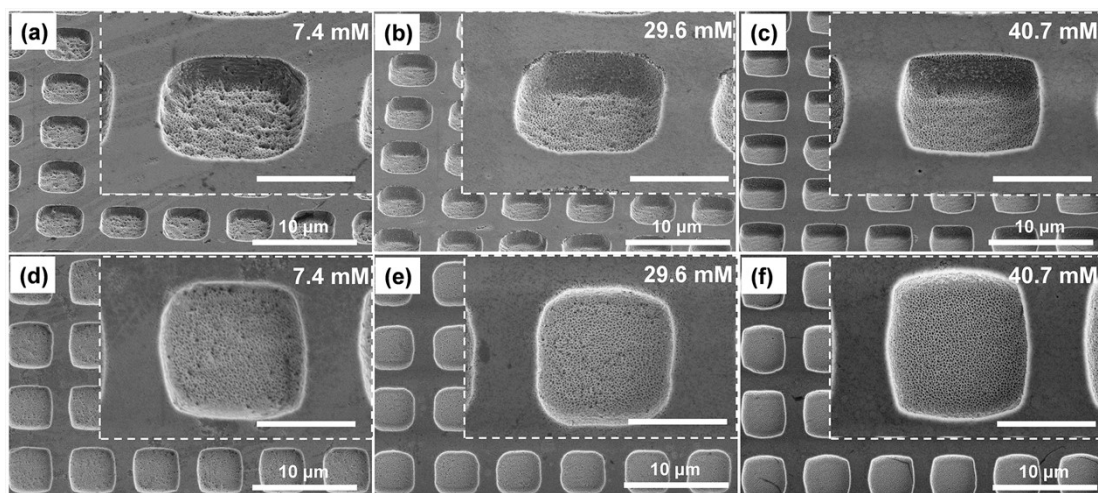


Figure S4. 45° tilted and top view SEM images of GaN hole array obtained from 30 min MacEtch with $K_2S_2O_8$ concentration of (a, d) 7.4 mM, (b, e) 29.6 mM, and (c, f) 40.7 mM respectively. Insets of (a-f) show the individual GaN hole with a scale bar of 3 μm. HF concentration was fixed at 14 M.

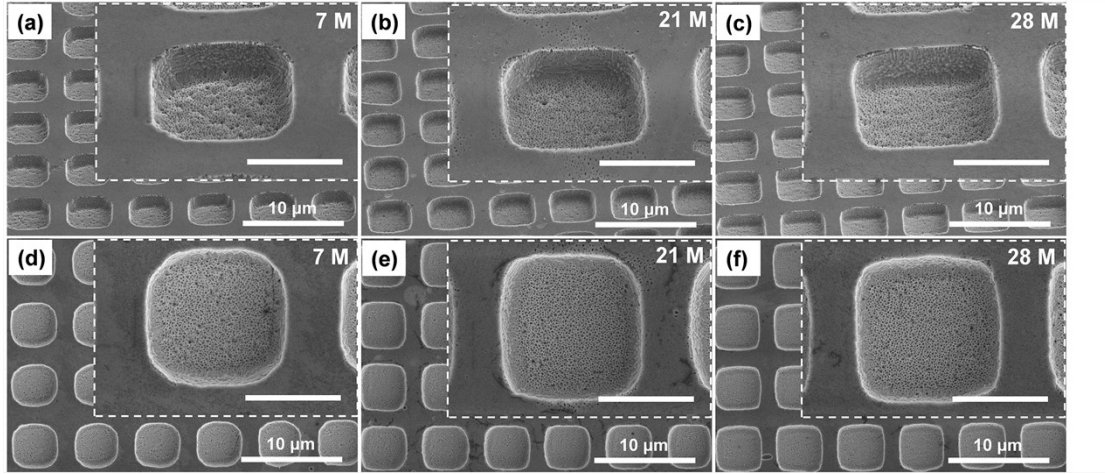


Figure S5. 45° tilted and top view SEM images of GaN hole array obtained from 30 min MacEtch with HF concentration of (a, d) 7 M, (b, e) 21 M, and (c, f) 28 M respectively. Insets of (a-f) show the individual GaN hole with a scale bar of 3 μm . $\text{K}_2\text{S}_2\text{O}_8$ concentration was fixed at 18.0 mM.

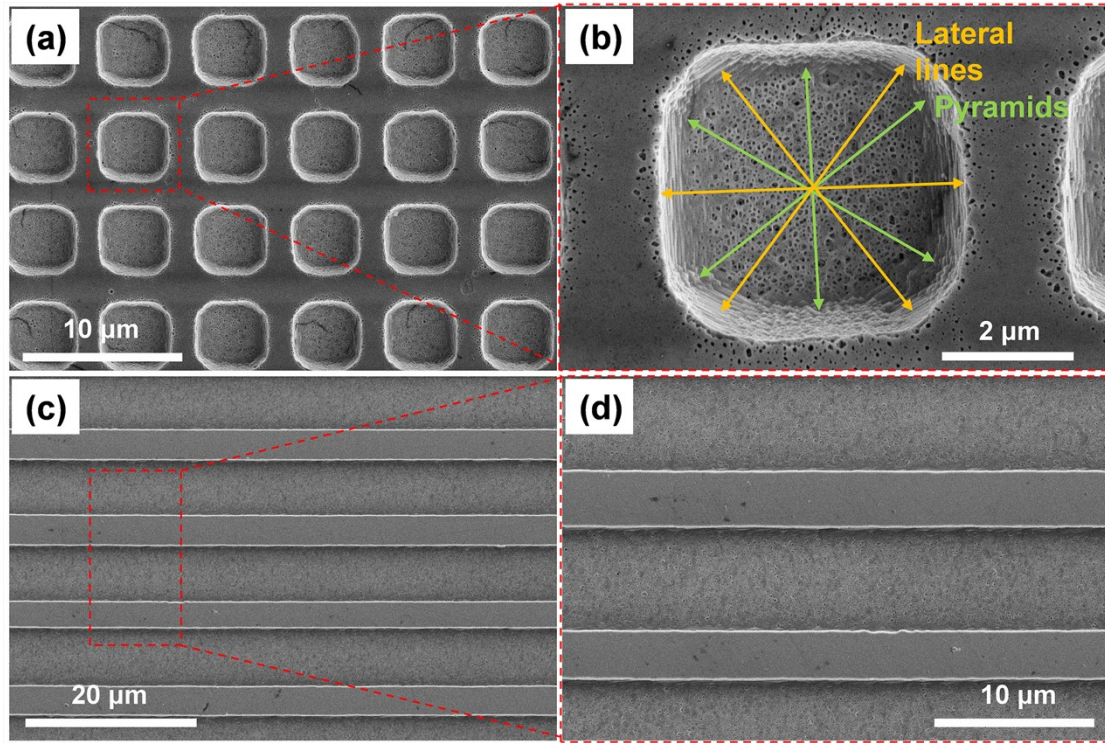


Figure S6. Top view SEM images of (a) GaN hole array and (c) GaN trench array after 3 min KOH smoothing. (b) and (d) show the zoom-in SEM images at etching front of (a) and (c), respectively. Orange and green arrows in (b) indicate the position of lateral lines and pyramid clusters.

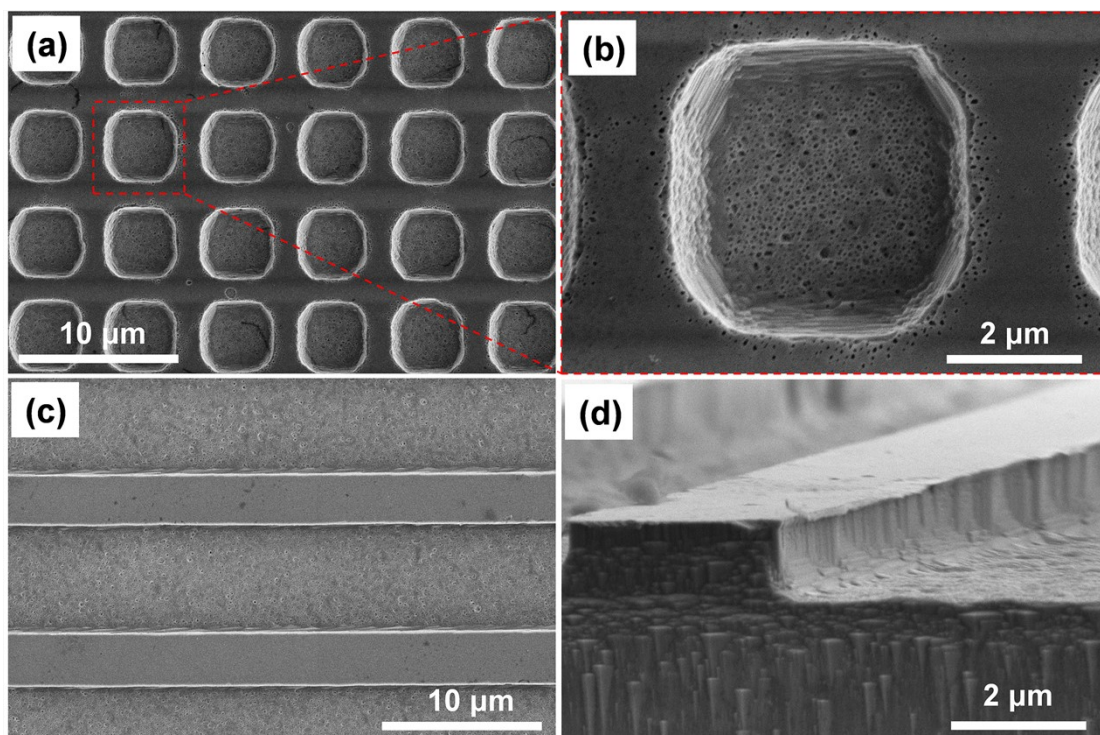


Figure S7. Top view SEM images of (a) GaN hole array and (c, d) GaN trench array after 6 min KOH smoothing. (b) shows the zoom-in SEM image at etching front of (a).

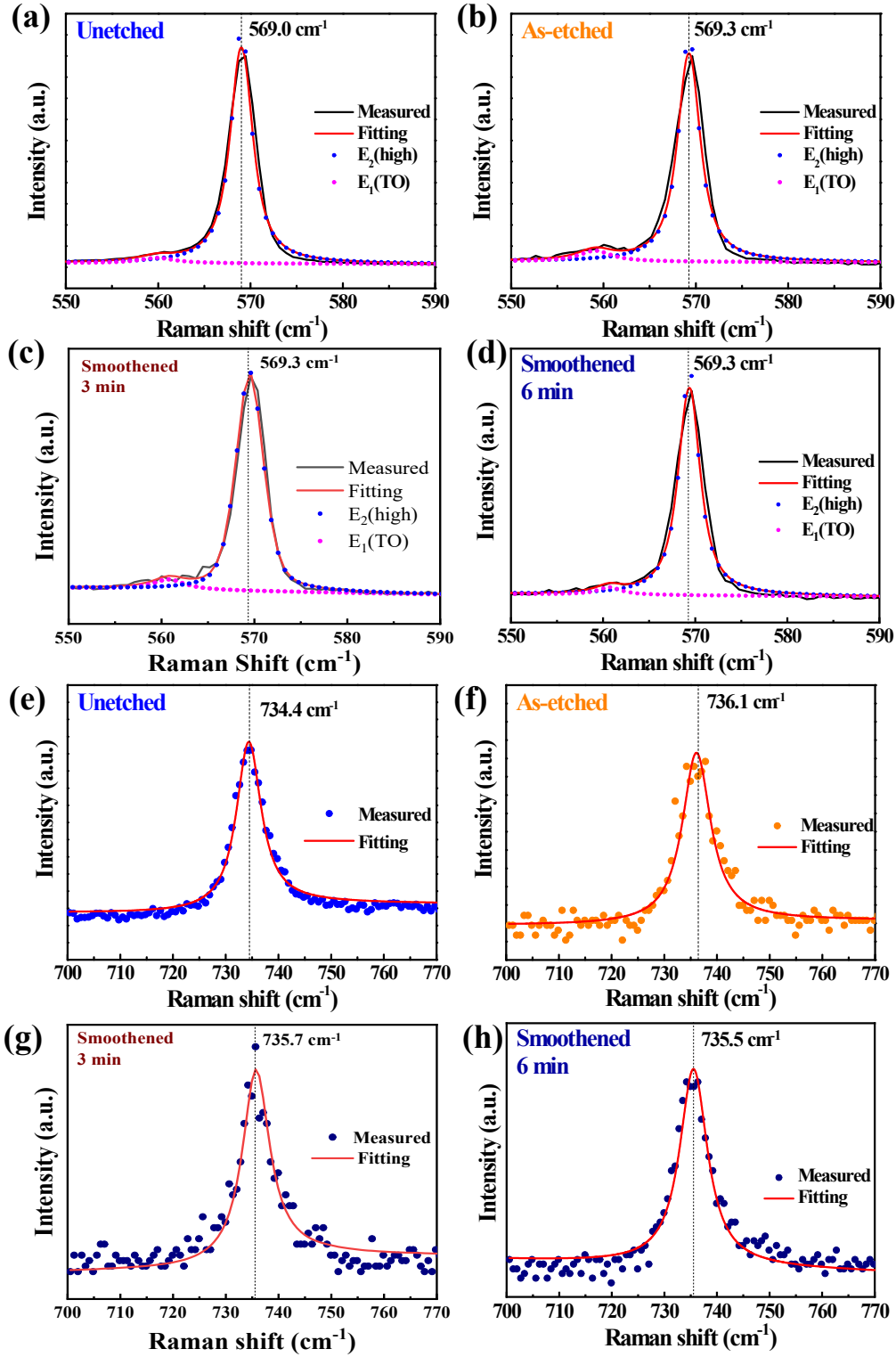


Figure S8. Lorentz fitting of Raman peak of (a, e) unetched, (b, f) as-etched, and (c, g) 3 min smoothed samples and (d, h) 6 min smoothed samples with spectra (a-d) from 550 ~ 590 cm⁻¹ and (e-h) from 700 ~ 770 cm⁻¹.