

Supplementary Information

for

Large-Size Free-Standing Single-crystal β -Ga₂O₃ Membranes Fabricated by Hydrogen Implantation and Lift-Off

by

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(1) Bulk β -Ga₂O₃ substrates:

Both [100] and [001]-oriented β -Ga₂O₃ homoepitaxy layers were grown on Fe-doped [100] and [001] substrates, respectively. The SEM images shown in Figure S1(a) and (b) present the surface images taken from [100] and [001]-oriented β -Ga₂O₃ substrate. Figure S1(c) indicates the thickness of the homoepitaxy layer from the angled SEM image. The thickness was measured to be 204.2 nm.

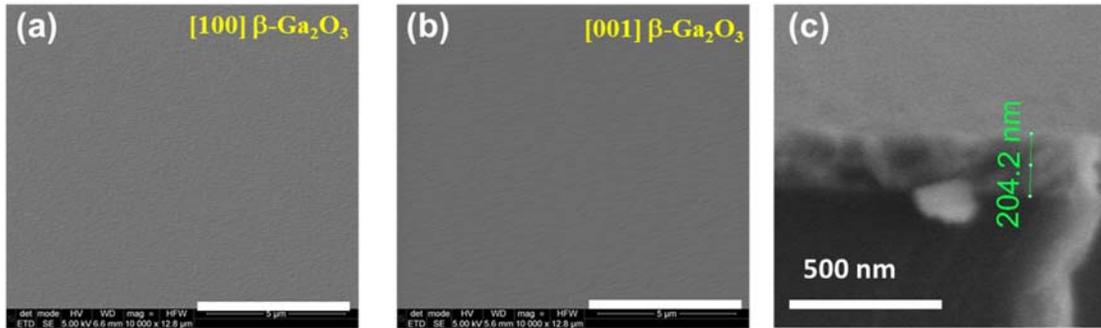


Figure S1. SEM image of the surface of (a) [100]-oriented β -Ga₂O₃ and (b) [001] oriented β -Ga₂O₃ sample. (c) an angled SEM image showing the thickness of homoepitaxy layer is measured to be 204.2 nm on top of 500 nm thick Fe-doped β -Ga₂O₃ substrate.

(2) A comparison of FWHM of XRD peaks from bulk and NM forms of [100] and [001]-oriented β -Ga₂O₃:

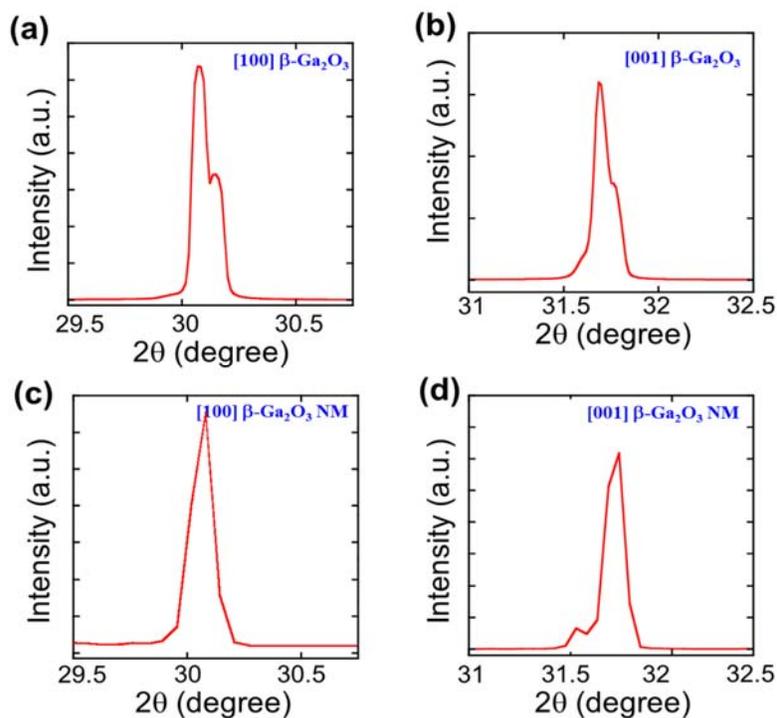


Figure S2. Measured XRD spectrum from (a) [100]-oriented β -Ga₂O₃ substrate and (b) [001]-oriented β -Ga₂O₃ substrate after the lift-off process, (c) [100]-oriented β -Ga₂O₃ NM and (d) [001]-oriented β -Ga₂O₃ NM after the lift-off process.

(3) XRD spectra from Bulk [100] and [001]-oriented β -Ga₂O₃ samples:

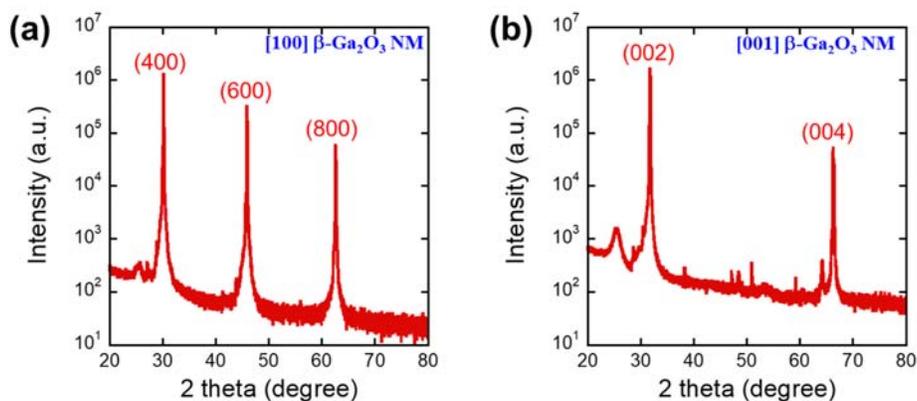


Figure S3. Measured XRD spectrum from (a) [100]-oriented β -Ga₂O₃ substrate and (b) [001]-oriented β -Ga₂O₃ substrate.

(4) Raman spectra taken from β -Ga₂O₃ NM on polyimide substrate under different bending conditions (uniaxial tensile strain).

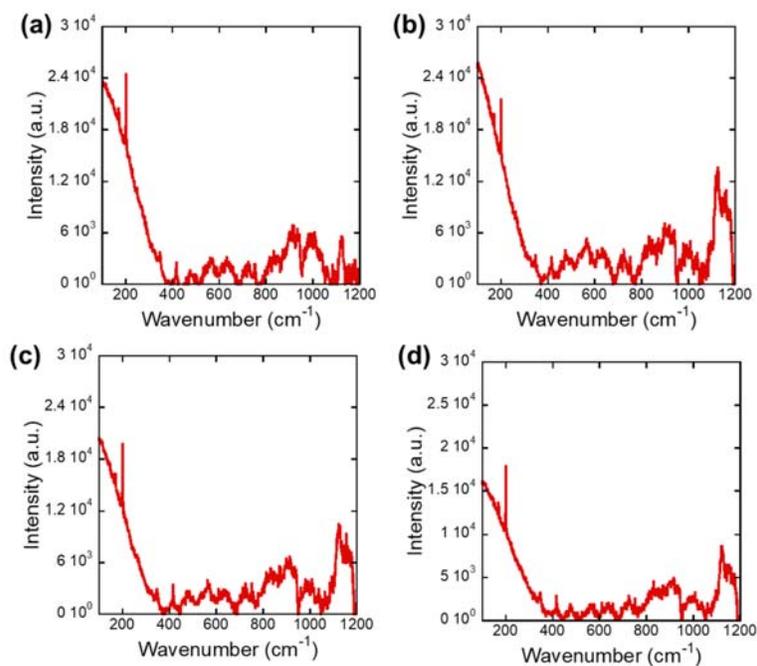


Figure S4. Measured Raman spectra (Raw data before the baseline subtraction) taken from β -Ga₂O₃ NM on polyimide substrate under different uniaxial tensile strain (a) 0.09%, (b) 0.127%, (c) 0.187%, (d) 0.32%, respectively.

(5) Raman spectra taken from β -Ga₂O₃ NM on polyimide substrate under different bending conditions (uniaxial compressive strain).

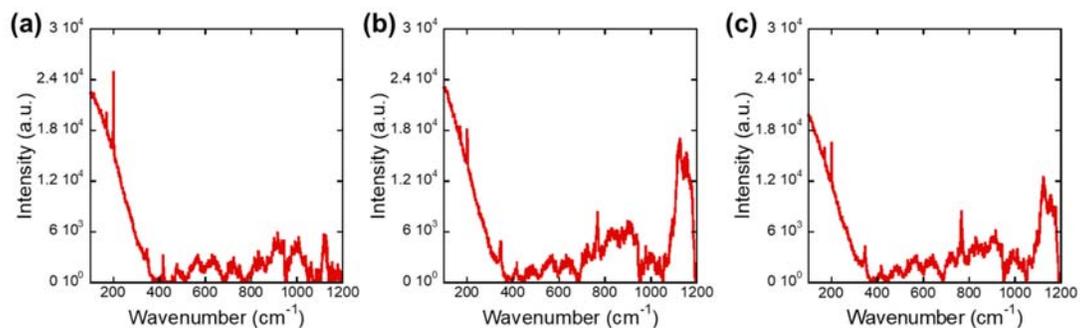


Figure S5. Measured Raman spectra (Raw data before the baseline subtraction) taken from β -Ga₂O₃ NM on polyimide substrate under different uniaxial compressive strain (a) 0.06%, (b) 0.09%, (c) 0.187%, respectively.