

Characterization of dry etch-induced surface damage of β -Ga₂O₃ using OBF-STEM imaging

Almost all of the vertical Ga₂O₃-based power devices have been fabricated using inductively-coupled Plasma (ICP) reactive-ion etching (RIE). However, the plasma cause would give negative impact to the property of the devices. The dry etch-induced structural degradation was characterized using conventional STEM imaging and optimum bright field (OBF) STEM imaging.

Characterization of the dry etch-induced surface damage by Conventional STEM imaging

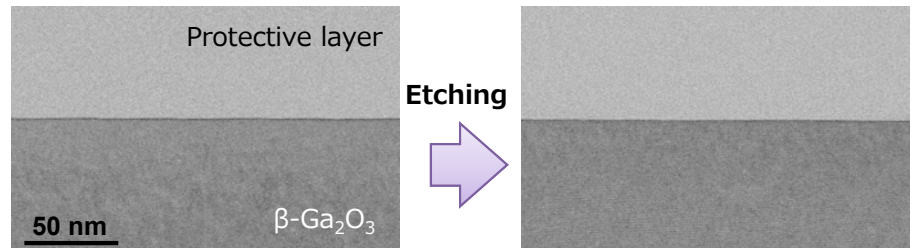
Sample

- Unintentionally-doped n-type β -Ga₂O₃
- Surface Orientation : (-201)

Etching condition

- Chamber condition: 120 m Torr
- Etchant gas: CF₄ / O₂, 20/10 sccm
- RF power: 80 W
- Etching time: 15 min

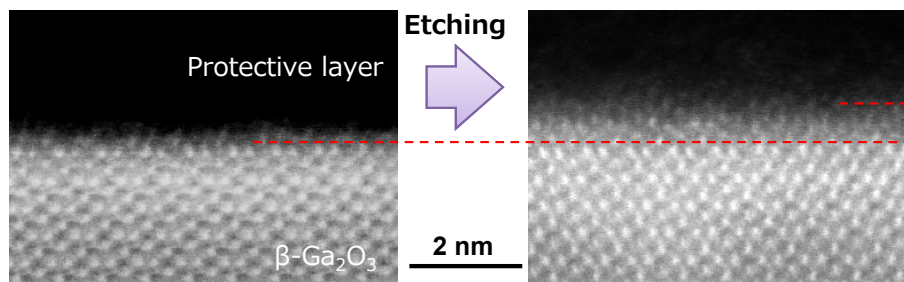
BF-STEM image



Etching

No large-size crystal defects near the surface of the β -Ga₂O₃ substrate

High-resolution HAADF-STEM image

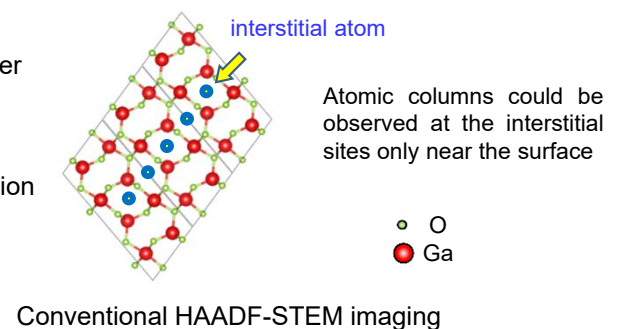
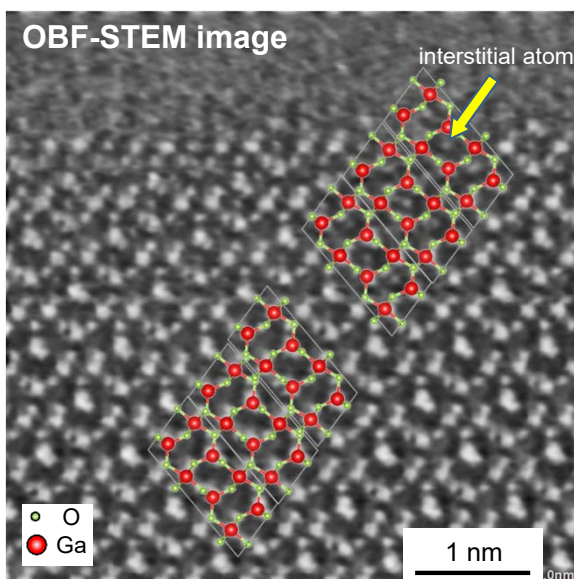


Etching

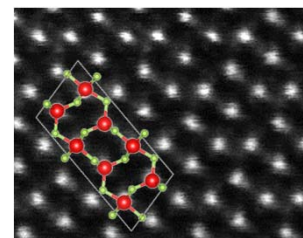
Damage layer on the surface
(less than 1 nm)

Characterization of the dry etch-induced surface damage by OBF-STEM imaging

OBF images can be leveraged by processing multiple images acquired by segmented/pixelated detectors through frequency filtering.



Conventional HAADF-STEM imaging



Structure in the damage layer was different from that inside substrate.

We believe that our novel analytical techniques such as OBF-STEM imaging can help your R&D