Structure Property Relationships in Wide-Gap Gallium Oxide Thin Films

Scientific Achievement

Successfully determined the synthesis space (substrate temperature, oxygen partial pressure, substrate selection) for the targeted growth of β-Ga_2O_3 thin films through theory-guided experiments. Grew high-quality, oriented β-Ga_2O_3 films.

Significance and Impact

Gallium oxide is of current interest as a wide-bandgap semiconductor for power electronics. Identifying the processing conditions necessary for high-quality film synthesis is a critical step toward developing this technology.

Research Details

Film Synthesis: Temperature-gradient combinatorial pulsed laser deposition was used to broadly map the synthesis space. Additional uniform samples were grown for detailed structural studies.

Structural Properties: The films crystallized into β-Ga_2O_3 above 250 °C, with the onset of exclusive 201 textured orientation at 450 °C. Epitaxial growth was achieved on Ga_2O_3, but twinned domains were observed for films on 0001 sapphire.

Optical and Electronic Properties: Substrate temperature and pO_2 had a large effect on electrical conductivity and visible transmission.

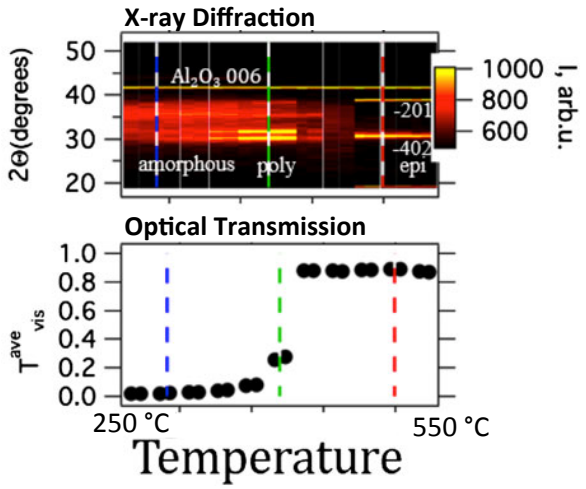

Fig. 1: X-ray diffraction and optical transmission of Sn-doped Ga_2O_3 films as a function of temperature.

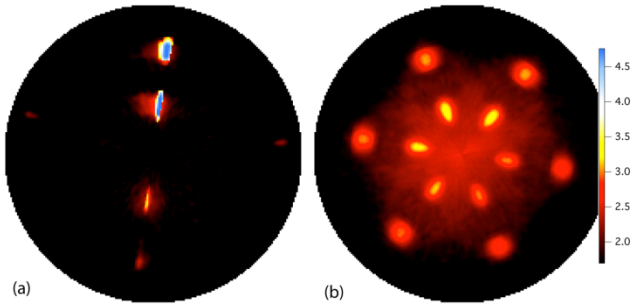

Fig. 2 (002) XRD pole figure of a 2% Sn: Ga_2O_3 films: a) Epitaxial growth on Ga_2O_3 single crystal; b) Bi-axially textured growth on sapphire single crystal.

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