American Ceramic Society

View Abstract

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CURRENT SYMPOSIUM: SYMPOSIUM 14: Crystalline Materials for Electrical, Optical and Medical Applications

CURRENT SESSION: Semiconductors for LED/LD, power device, sensor

PRESENTATION TYPE: Invited (by Invitation Only)

TITLE: Crystals and Substrates for Next-Generation Oxide Semiconductor Devices

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ABSTRACT BODY:

Abstract Body: The growth of oxide single crystals from the melt at high temperatures is key to enable novel wide band-gap oxide semiconductor technology. We developed 2-inch diameter gallium oxide (β-Ga_2O_3) bulk crystals grown from melt by the Czochralski method. Recently, we extended our research to develop the corresponding ternary compound β-$(Al_xGa_{1-x})_2O_3$ (AlGaO) that will allow for band-gap tuning and electron confinement. While the monoclinic structure is retained up to x = 0.4, electrical conductivity in Si doped samples deteriorates for x > 0.15, and thermal conductivity suffers even from low amounts of aluminum due to impurity scattering.

Rutile GeO_2 is another novel semiconductor (bandgap 5.0–5.5 eV) with promising properties for power electronics applications. We prepared first bulk single crystals with good structural quality and high electrical conductivity when lightly doped with Sb. However, the bulk crystal growth is exceedingly difficult due to high viscosity of the melt, glass formation, and a phase transition. Thus, we utilized alkaline carbonate fluxes.

Finally, $BaSnO_3$ is considered an oxide with 2DEG formation. As $BaSnO_3$ single crystals are very difficult to grow in the required size, we developed bulk growth of the lattice-matched compounds $LaInO_3$, Ba_2ScNbO_6 and $(Nd,La)(Lu,Sc)O_3$. However, the very high melting temperature of these compounds (about 2150°C) makes preparation challenging.

KEYWORDS: gallium oxide, germanium oxide, power semiconductor, oxide semiconductor, substrate, single crystal.

Presenter Acknowledgment: I have read and acknowledge the above paragraph

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