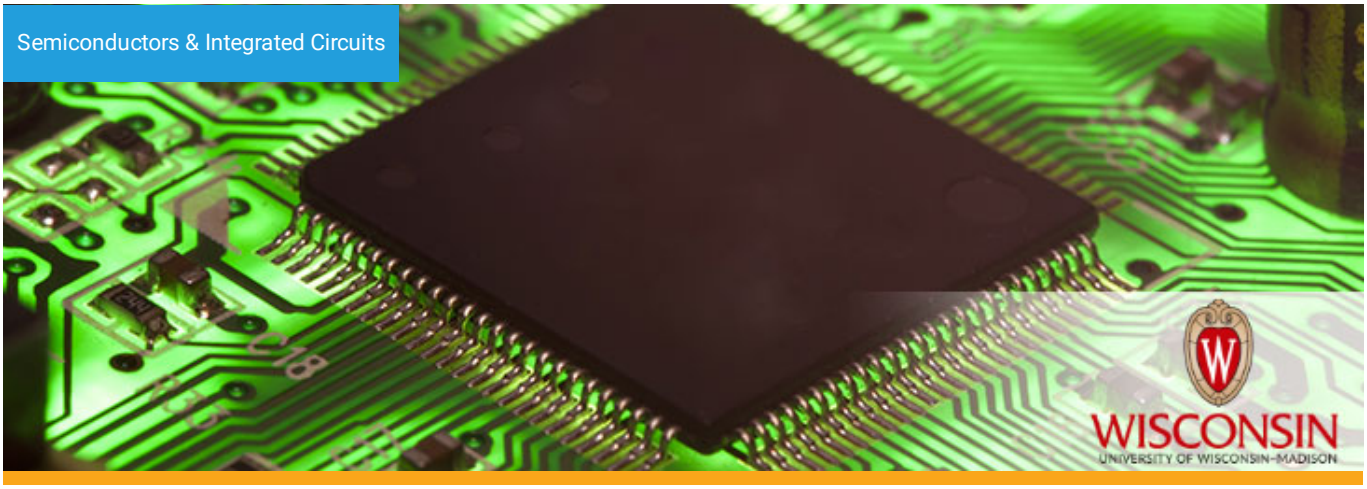

LOW-DEFECT-DENSITY GAMMA PHASE ALUMINUM OXIDE SUBSTRATES FOR HETEROEPITAXIAL SYNTHESIS

View U.S. Patent No. 11,879,185 in PDF format.

WARF: P210285US01

Inventors: Chang-Beom Eom, Rui LIU, Paul Evans, Donald Savage, Thomas Kuech

Overview

Oxide thin films have widespread applications in electronic, magnetic, optical materials and devices. Synthesis of oxide thin films via epitaxial growth techniques such as sputtering, molecular beam epitaxy, pulsed laser deposition, and solid phase epitaxy (SPE) largely rely on the single crystal substrates used to provide crystal templates for thin films. Broadening the substrate family for oxides has critical applications in engineering the properties of oxide thin films. The most commonly used substrates for perovskite oxides, for example, SrTiO3, do not provide substrates with lateral sizes larger than approximately 2 cm, which in some cases limits the technological application of oxide thin films.

The Invention

UW researchers have developed a method for the epitaxial synthesis of thin films of cubic γ-Al2O3 with low-defect density. These methods can be employed with large-area α-Al2O3 wafers. The synthesis uses SPE to achieve a precise selection of the structural phase of Al2O3. The γ-Al2O3 thin films produced in this way are candidate substrates for oxide thin films with cubic or hexagonal structures. The use of low defect-density γ-Al2O3 layers can broaden the choices of lattice parameters of substrates for oxides and enable large-area processing on low-defect density commercial substrates. SPE in general involves creating an amorphous thin film on a crystalline substrate then heating at a temperature and duration selected to form epitaxial thin films.

Applications

The single crystal γ-Al2O3 thin films with low-defect density created via this method can be used as substrates for the synthesis of oxides with cubic or hexagonal structures. The cubic crystallographic symmetry and the value of the lattice parameter are a good match for many oxides, especially the perovskite oxides. Some potential application areas are:

- Piezoelectric PZT thin films for ultrasound and integrated optics applications
- BFO for lead-free piezoelectric applications, KTO for superconductors
- SVO for electrodes for photovoltaic cells and to create smart windows
- Garnets for magneto-optical devices and spintronic devices.
- Highly miscut substrates can also be used to form single domain γ-Al2O3, which has potential applications in oxide radiofrequency electronics

Key Benefits

These advances in the synthesis of γ-Al2O3 allow the formation of complex oxide thin films on comparatively inexpensive, widely available α-Al2O3 substrates. The large area of the γ-Al2O3 substrates potentially allows applications requiring dimensions greater than a

few cm, including integrated optics.

Additional Information

For More Information About the Inventors

- Paul Evans
- Chang-Beom Eom
- Thomas Kuech

Publications

- Liu R, Elleuch O, Wan Z, Zuo P, Janicki TD, Alfieri AD, Babcock SE, Savage DE, Schmidt JR, Evans PG, Kuech TF. Phase Selection and Structure of Low-Defect-Density γ-Al2O3 Created by Epitaxial Crystallization of Amorphous Al2O3. ACS Appl Mater Interfaces.

Tech Fields

- Semiconductors & Integrated Circuits : Components & materials

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867