Apparatus and Method Developed for the Deposition of Complex Oxide Thin Films Inside The Water Cooled Port Of Sputtering Chamber Using Pulsed Plasma

IITM Technology Available for Licensing

Problem Statement

- Achieving precise control over composition, crystal structure, and uniform thicknesses during the synthesis of epitaxial thin films of complex oxides is a critical challenge.
- Fabricating high-quality thin films over large areas with uniform properties and stoichiometric compositions remains a significant hurdle for the commercialization of oxide-based electronic devices.
- While sputter deposition is versatile for fabricating oxide films, challenges persist in balancing deposition rate, film damage, and uniformity, necessitating advancements in deposition techniques for improved performance and scalability.

Intellectual Property

- IITM IDF Ref. **1627**
- **IN 375274 - Patent Granted**

Technology Category/ Market

Category- Thin Film Deposition Techniques
Applications - Electronic Devices, Magnetic Storage and Spintronics, Optoelectronics.
Industry - Semiconductor, Data Storage

Market- Sputter Coater Market size is projected to reach USD 1,149.69 Million by 2030, growing at a **CAGR of 5.4%.**

TRL (Technology Readiness Level)

TRL - 4: Technology validated in lab scale.

Research Lab

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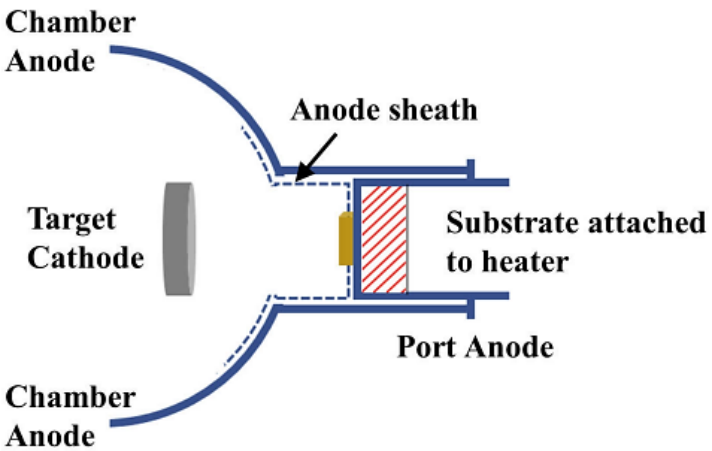

FIG. 1. Schematic illustration of the cross section of the anode sheath envelope for the plasma inside the water cooled port.

Technology

1. **Advanced Sputter Deposition Apparatus:** The invention presents a method and apparatus for sputter deposition of transition metal oxide thin films and heterostructures on single crystal substrates, offering precise control over deposition parameters such as target-substrate distance, sputtering power, and substrate temperature.
2. **Versatile Deposition System:** The sputtering apparatus consists of multiple components including a spherical chamber, pumping system, sputtering gun assembly, substrate heater, sputtering gas atmosphere, and power supply, enabling flexible control over the deposition process and facilitating the growth of high-quality thin films over large areas.
3. **Enhanced Deposition Control:** By incorporating features such as pulsed plasma deposition and adjustable target-substrate distance, the apparatus allows for the deposition of thin films with uniform thickness, structural uniformity, and stoichiometric compositions, opening possibilities for the fabrication of superlattices and heterostructures with precise nanoscale control.

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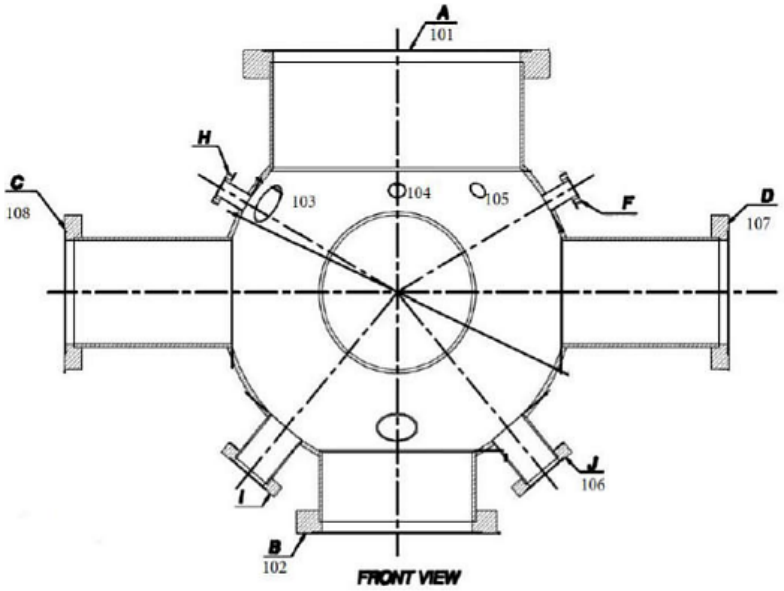

FIG. 2. Schematic illustration of the sputtering chamber front-view.

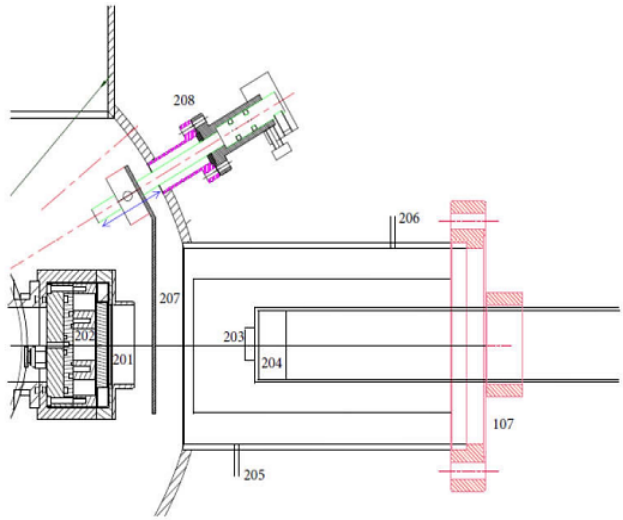

FIG. 3. Schematic illustration of the cross-section of part of a sputtering gun, a shutter and a heater in a section of the sputtering chamber.

Key Features / Value Proposition

1. **1. Enhanced Deposition Precision:**
   - Offers precise control over deposition parameters for uniform and stoichiometrically accurate thin film growth.

2. **Versatile Deposition Capabilities:**
   - Enables deposition of transition metal oxide thin films and heterostructures on single crystal substrates with or without amorphous layers.

3. **Scalable Deposition System:**
   - Facilitates deposition over large surface areas, including areas of at least 2 inches, suitable for industrial-scale production.

4. **Advanced Control Features:**
   - Incorporates pulsed plasma deposition and adjustable target-substrate distance for enhanced control over growth rate and thickness uniformity.

5. **High-Quality Thin Films:**
   - Produces high-quality thin films characterized by reproducible crystal structures and stoichiometry, confirmed through x-ray diffraction and magnetic phase transition analysis.

6. **Nanoscale Precision:**
   - Allows for the fabrication of superlattices and heterostructures with nanoscale thickness control, opening avenues for advanced electronic and optoelectronic devices.

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