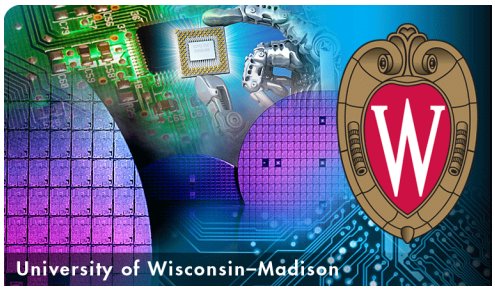

Real-Time Monitoring of Sputtered Thin Films

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WARF: P160067US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing methods that, for the first time, enable *in situ* RHEED analysis of films deposited via off-axis magnetron sputtering.

OVERVIEW

Atomic layer controlled growth is essential for the understanding and engineering of complex thin film surfaces and heterointerfaces. To ensure quality, various deposition techniques take advantage of a highly sensitive real-time analytical tool called reflection high-energy electron diffraction (RHEED). RHEED is used to monitor the film surface during deposition, enabling layer-by-layer control at a very precise level.

To date, one technique that has not been able to take advantage of RHEED analysis is magnetron sputtering. Scalable and commercially attractive, the technique is commonly used to produce complex oxide thin films for semiconductors and other applications. Sputtering and RHEED have been considered incompatible due to the strong magnetic fields and high pressures that adversely effect the RHEED electron beam. Attempts to incorporate a RHEED system into conventional single-gun sputtering systems lead to beam deflection.

THE INVENTION

UW–Madison researchers have developed methods that combine off-axis sputter deposition with *in situ* RHEED analysis. Using a new multi-gun approach, films are grown and monitored in a single vacuum chamber that houses components of both systems. In this setup the sputtering magnets are used to align the RHEED electron beam. The problem of beam deflection is addressed by applying antisymmetric magnet configurations to the assembly, resulting in a highly predictable bending of the beam.

THE WARF ADVANTAGE

Since its founding in 1925 as the patenting and licensing organization for the University of Wisconsin-Madison, WARF has been working with business and industry to transform university research into products that benefit society. WARF intellectual property managers and licensing staff members are leaders in the field of university-based technology transfer. They are familiar with the intricacies of patenting, have worked with researchers in relevant disciplines, understand industries and markets, and have negotiated innovative licensing strategies to meet the individual needs of business clients.

APPLICATIONS

- Fabrication of high quality epitaxial thin film heterostructures and superlattices (e.g., for use in insulators, semiconductors, superconductors, dielectrics, piezoelectrics, linear optic materials and more)

KEY BENEFITS

- Allows for rapid optimization of growth parameters
- Makes it possible to compare film quality and roughness throughout dynamic growth process
- Offers real-time digital control of the exact thickness of each layer
- Enhances reproducibility of the interfaces and provides for superlattice growth
- Provides fundamental insights into epitaxial growth mechanisms that are currently unknown

STAGE OF DEVELOPMENT

The researchers have demonstrated digital control of sputter deposition using *in situ* high pressure RHEED by applying the technique to the widely studied model oxide system, $SrRuO_3$ (SRO). During 90 degree off-axis sputtering of SRO films, strong specular spot oscillations extending beyond 50 unit cells were observed. This allowed identification of the growth mode as layer-by-layer and established the ability to have unit cell control during sputter growth.

Similar results were seen during the growth of perovskites $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and $LaAlO_3$ (LAO), confirming that this approach can be universally applied to sputter deposition of other materials.

ADDITIONAL INFORMATION

Related Technologies

See WARF reference number P120150US01 for information about the researcher's off-axis apparatus and technique to fabricate high quality thin films.

Tech Fields

Semiconductors & Integrated Circuits - Components & materials

CONTACT INFORMATION

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842.