Announcing the Final Examination of Asim Khaniya for the degree of Doctor of Philosophy in Physics

Date: November 16, 2020
Time: 3:15 p.m.
Room: https://ucf.zoom.us/j/95931206365 (Meeting ID: 959 3120 6365)
Dissertation title: Preparation and Characterization of Epitaxial Thin Films with Applications in Catalysis and Microelectronics

Abstract:

Ubiquitous in the modern world, the epitaxial thin film offers a wide range of practical applications in the field of microelectronics, solar industries, optical devices, and catalysis. This thesis deals with studying the growth and characterization of molybdenum nitride (MoN) and various dielectric encapsulated Ru(0001) thin films on single-crystal substrates. The phase-specific and single-crystalline MoN film was grown epitaxially on pre-nitrogen-covered Ru(0001) via physical vapor deposition and characterized by UHV based surface science analytical techniques including X-ray photoelectron spectroscopy, helium ion scattering spectroscopy, auger electron spectroscopy, and low energy electron diffraction. The annealing temperature of 700 K was found to result in well-ordered hexagonal films that appear to grow layer-by-layer initially and in registry with the Ru(0001) support. The MoN film starts to decompose via a presumptive N_2 recombinative desorption mechanism upon annealing above T = 700 K, which leaves the film in a purely metallic Mo-Ru configuration by T = 1100 K. The oxidation kinetics of hexagonal MoN at ambient conditions is also studied in this work.

Enhanced scattering of electrons at surfaces is a critical factor for the resistivity size-effect observed in single-crystalline nanoscale metals. In this work, we have investigated the surface-dependent effects on resistivity for oxide-capped Ru(0001) films with thickness in the nanometer regime. XPS and LEED are utilized to monitor the change in the chemistry and structure of the Ru(0001) interface. The variation in resistivities resulting from presumptive changes in surface structure and chemistry were related to the changes in the Ru surface's specularity (p) for electron scattering in the context of the Fuchs-Sondheimer semi-classical model. In this context, we have demonstrated a fully (reversibly) tunable specularity at the metal interface (from fully specular to fully diffuse), buried under the amorphous oxide dielectrics.

Outline of Studies:
Major: Physics

Educational Career:
B.S. Tribhuwan University, Nepal, 2010
M.S. Tribhuwan University, Nepal, 2014
M.S. University of Central Florida, FL, 2016

Committee in Charge:
Dr. William Kaden (Chair)
Dr. Talat Rahman
Dr. Mihai Vaida
Dr. Kevin Coffey (External Committee Member)

Approved for distribution by Dr. William E. Kaden, Committee Chair, on November 4th, 2020.

The public is welcome to attend remotely.