cathode current were monitored. Increasing the gas flow rate from 10 sccm to 100 sccm caused the cathode current to decrease by ~25%, but on reversing the flow rate, the cathode current did not go back up along the same curve, instead exhibiting a hysteretic behavior. A similar trend was observed for the change in oxygen partial pressure between 0 and 20% as well. The width and position of the hysteresis curve depends on the relative values of the gas flow rates and the oxygen partial pressures. VO thin films deposited at various points along the hysteresis curve were evaluated using four-point resistance measurements over a wide temperature range. The room temperature resistivity of the films varied by more than six orders of magnitude and was found to have a progressive dependence on the cathode current. Structural characterizations such as X-ray diffraction and transmission electron microscopy studies indicated that the microstructure changes gradually from nano-crystallite to amorphous nature with the increase in total gas flow rate and/or oxygen partial pressure.

TF1-MoM10 Composition and Structural Evolution of Sputtered Ti-Al-N
P.H. Mayrhofer, L. Chen, M. Moser, Montanuniversität Leoben, Austria, Y. Du, Central South University, China

The compositional and structural evolution of Ti-Al-N thin films as a function of the total working gas pressure (pT), the N2-to-total pressure ratio (pN2/pT), the substrate-to-target distance (ST), the substrate position, the magnetron power current (Ic), the externally applied magnetic field, and the energy and the ion-to-metal flux ratio of the ion bombardment during reactive sputtering of a Ti0.5Al0.5 target is investigated in detail. Based on this variation we propose that the different poisoning state of the Ti and Al particles of the powder-metallurgically prepared Ti0.5Al0.5 target in addition to scattering and angular losses of the sputter flux cause a significant modification in the Al/Ti ratio of the deposited thin films ranging from ~1.05 to 2.15. The compositional variation induces a corresponding structural modification between single-phase cubic, mixed cubic-hexagonal and single-phase hexagonal. However, the maximum Al content for single-phase cubic TixAl1-xN strongly depends on the deposition conditions and was obtained with x = 0.66, for the coating deposited at 500 °C, pL = 0.4 Pa, ST = 95 mm, and pN2/pT = 17%. Our results show that, in particular, the N2-to-total pressure ratio in combination with the sputtering power density of the Ti0.5Al0.5 compound target has a pronounced effect on the Al/Ti ratio and the structure development of the coatings prepared.

Thin Film
Room: B4 - Session TF2-MoM

Metals and Nitrides (ALD/CVD)
Moderator: W.M.M. Kessel, Eindhoven University of Technology, the Netherlands

8:20am TF2-MoM1 ALD of Metal Chalcogenide Thin Films. M.A. Leskela, T. Hatunpaa, M.J. Heikkila, V.J. Pore, M.K. Ritala, University of Helsinki, Finland

INVITED ALD of metal sulphide thin films has been known since the discovery of the technology in early 70s whereas ALD of metal selenide and telluride films has been limited because of a lack of precursors that would at the same time improve the electrical properties (20 Ωcm for >5 nm films), and the polycrystalline structure are similar for both ALD processes. However, despite the drastically improved nucleation, the remote plasma ALD Ru films show a lower level of carbon impurity (<0.1 at.%), while a low level of carbon (<0.5 at.%) is segregated near the grain surface during Ru deposition. Analysis by an atomic probe microscope shows that the carbonates are nearly free of carbon impurity (<0.1 at.%), while a low level of carbon (<0.5 at.%) is segregated near the grain boundaries. The atom probe microscope also shows that a small amount of O impurity (0.3 at.%) is distributed uniformly through the crystallites and the grain boundaries.


Ruthenium thin films were deposited by pulsed chemical vapor deposition from bis(NV-di-tert-butylacetamidinato) ruthenium(II) dicarbonyl and O2. Highly conductive, defect-free, and pure thin Ru films can be deposited when oxygen exposure E0 approaches a certain low threshold (E0min). When E0 > E0min, the films peel off silica substrates, perhaps due to recombinative desorption of O2 at the film/substrate interface. Ruthenium films grown on tungsten substrates show very strong adhesion, > 17 J/m², and no evidence for any oxidized interlayer between the Ru and the W. Thus, oxygen exposure does not oxidize the tungsten substrate during Ru deposition. Analysis by an atomic probe microscope shows that the crystallites are nearly free of carbon impurity (<0.1 at.%), while a low level of carbon (<0.5 at.%) is segregated near the grain boundaries. The atom probe microscope also shows that a small amount of O impurity (0.3 at.%) is distributed uniformly through the crystallites and the grain boundaries.