Conference: PXRNMS 2018 (France)

Abstract submission deadline: 05 September 2018

Presentation type: Oral

Metal-on-metal interface formation laws of nanoscale thin films

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In thin film-based devices, there is a constant effort to prevent or at least limit interlayer formation between the layers. Interface effects become much more critical especially in the case of nanoscale thin film systems. Although there has been a tremendous development in post-deposition characterization of thin film structures, there is currently a limited capability to accurately predict the interface formation between two layers without having to deposit test structures. In this work, we use low energy ion scattering (LEIS) to systematically measure the interface thickness for several transition metal-on-transition metal (TM-on-TM) sputter deposited thin films and identify a scaling law for interface formation between any two TM layers. We find that there is a clear trend in interface thickness with respect to difference in surface energies of the layers and there is a subtrend based on the crystal structure of the metal layers. Based on these two materials properties, the interface thickness for any given TM-on-TM combination can be predicted with sub-nanometer level accuracy. This ability improves the possibility to control interface properties and thus, achieve the best possible thin film structure for the desired application.