

## COMPLEMENTARY X-RAY ANALYSIS OF SPUTTERED MAGNETIC AND MICROELECTRONIC DEVICE RELATED FILM MATERIALS

A.A. Tijerina, A.G. Ayala, S. Rios and C.J. Gutierrez  
Southwest Texas State University, San Marcos, TX, USA, 78666

We present examples illustrating the usefulness of coordinated grazing incidence x-ray reflectivity (XRR), parallel beam x-ray diffraction (PBXRD) and x-ray fluorescence (XRF) towards assessing the structural properties of metallic, nitride and oxide film materials potentially useful for magnetic film device and integrated circuit device fabrication. The film materials were fabricated using either magnetron sputtering or dual ion beam sputtering under various plasma and reactive conditions guided by post-deposition x-ray characterization.

First, we explored the characteristics of magnetron sputtered TaN and TiN diffusion barrier layers on thermal oxide coated silicon substrates. XRR data coupled with simulation modeling (the Bede Scientific Mercury REFS algorithm) was used to identify the development of a buried roughened tantalum or titanium oxide interfacial layer (typically ~7 nm) in these ~50 nm thick nitride films despite the presence of a reactive nitrogen plasma during sputtering. In addition, we report the development of a smoother and thinner (~2 nm) surface oxide layer in the nitride films presumably upon exposure to air after film growth. PBXRD data on film crystallinity will also be reported.

In addition, ion beam sputtered permalloy ( $\text{Ni}_{81}\text{Fe}_{19}$ ) magnetic film processed under various ion beam assist and inert gas (Ar versus Kr) plasma conditions were assessed with XRF and magnetometry to determine the effect of low energy ion assist processing for reducing the effective sticking coefficient of permalloy on oxidized silicon substrates. Furthermore, the introduction of reactive oxygen ions for forming the metastable permalloy monoxide phase was investigated by PBXRD. This x-ray analysis will be useful for determining the optimal reactive plasma processing conditions for producing exchange biased magnetic films potentially useful for magnetic device applications.