

Abstract No. Luss0262

### Characterization for Strontium Titanate/ $\text{Fe}_3\text{O}_4$ and TiN/ $\text{Fe}_3\text{O}_4$ Interfaces

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Beamline(s): U4B

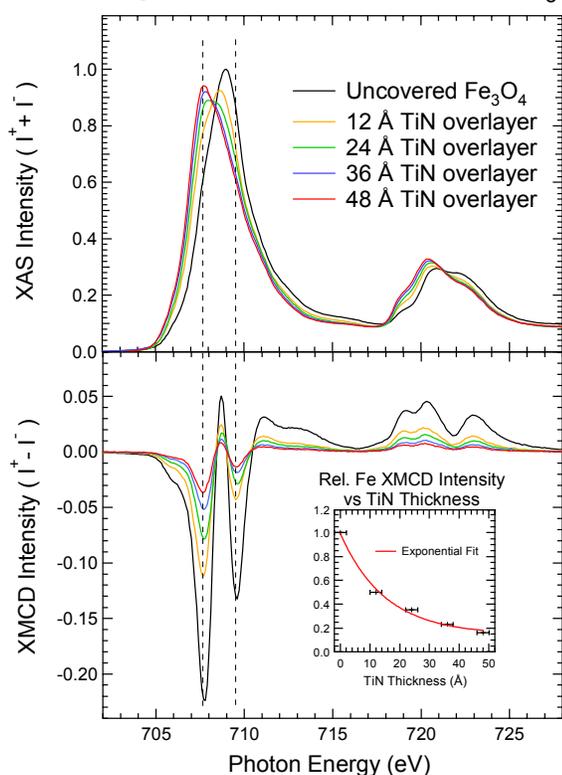
**Introduction:**  $\text{Fe}_3\text{O}_4$  is theoretically a half metallic ferromagnet. It thus has interesting applications in spin devices. However, in order to be useful it must be successfully interfaced with various materials. We studied the effects of two overlayer materials on the  $\text{Fe}_3\text{O}_4$  interface.

**Methods and Materials:** The interface formation between different thicknesses of strontium titanate ( $\text{SrTiO}_3$ ) or titanium nitride (TiN) with a 2000 Å  $\text{Fe}_3\text{O}_4$  film was studied using x-ray absorption spectroscopy (XAS) and x-ray magnetic circular dichroism (XMCD).

**Results:** Our results show that the deposition of 10-50 Å of TiN results in an immediate and substantial removal of oxygen from the near interface region, resulting in the formation of FeO interlayers. This is confirmed first by a chemical shift of the  $L_3$  line of iron from its position in  $\text{Fe}_3\text{O}_4$  to its position in FeO (lower binding energy). Secondly, the XMCD signal concurrently decreases, confirming the disappearance of the ferromagnetic state of the iron oxide ( $\text{Fe}_3\text{O}_4$ ). Additionally, from the relative intensity of the XMCD signal we can evaluate the proportion of  $\text{Fe}_3\text{O}_4$  that transformed to FeO near the interface.

For the deposition of  $\text{SrTiO}_3$  on  $\text{Fe}_3\text{O}_4$  our measurements show only a small deviation from the  $\text{Fe}_3\text{O}_4$  characteristic XAS signature, suggesting the limited formation of perhaps only one monolayer of another Fe oxide at the interface. However, the XMCD signal that is persistent except for two overlayer thicknesses (22 and 24 Å) confirms the preservation of  $\text{Fe}_3\text{O}_4$  in its ferromagnetic state. For these two cases, the lack of a chemical shift confirms the loss if XMCD is not due to the formation of FeO, but another structural effect.

Fe L-edge Spectra for TiN covered  $\text{Fe}_3\text{O}_4$



Fe L-edge Spectra for STO covered  $\text{Fe}_3\text{O}_4$

