Probing the electronic and magnetic properties of magnetic oxides using resonant photoemission study

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The electrical and magnetic properties of any transition metal oxide are related to its electronic structure. Resonant photoemission spectroscopy (RPES) is a novel technique to understand the valence band structure of any transition metal based oxide material. In the present talk, I shall discuss the results of different classes of magnetic oxide materials. These materials are grown in thin film form using pulsed laser deposition. X-ray photoelectron spectroscopy, and RPES measurements have been performed at AIPES beamline at Indus-1, RRCAT, Indore. For over a decade, TM doped semiconducting oxides based dilute magnetic semiconductors (DMS) have attracted a huge attention of condensed matter community owing to its prospects in spintronic applications. To better understand the effect of TM doping or presence of defects on the electrical and magnetic properties, it is crucial to realize modification in the host semiconducting oxide's electronic properties. We have investigated the electronic and magnetic properties of the pulsed laser deposited epitaxial thin films of Fe doped (4 at. %) and undoped anatase TiO2-d by resonant photoemission, resistivity, magnetization measurements and ab-initio band structure calculations. Our study reveals the formation of local magnetic moment and finite density of states at the Fermi level indicating its metallic (degenerate semiconducting) behaviour in both the films, leading to magnetic ordering at room temperature and a Kondo minimum in resistivity behaviour. Present work suggests that there is a competition between magnetic ordering mechanism by JRKKY and moment screening mechanism by JKondo. In the light of this result the role of carrier density is also discussed in achieving the magnetic ordering in DMS materials either by defect engineering or by transition metal doping.

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