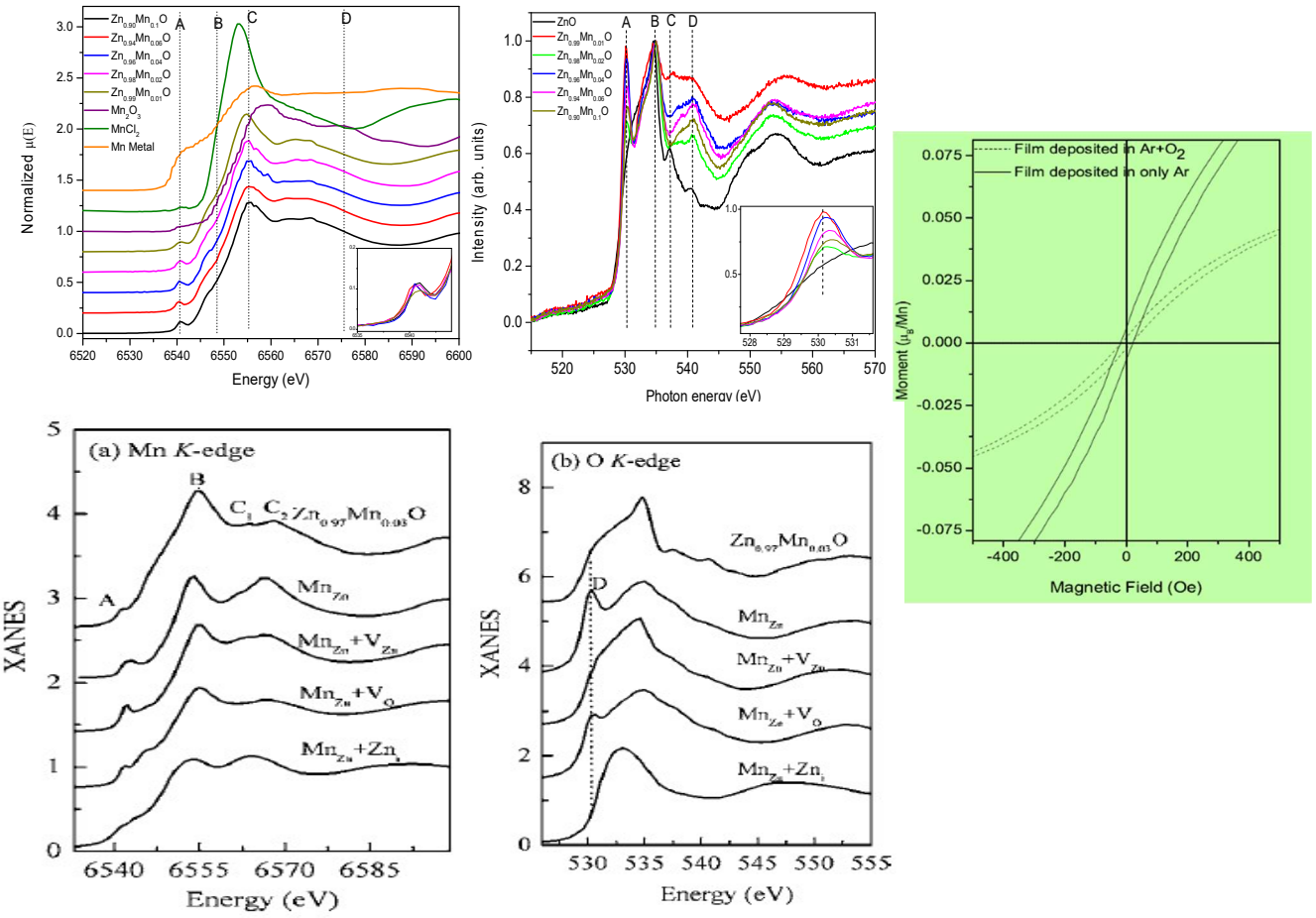
- **XAS study on Dilute Magnetic Semiconductor (DMS) systems (2015)**



Dilute magnetic semiconductors which are formed by incorporating small amount of transition metals (TM) in semiconductor hosts are considered to be potentially important materials for spintronics applications. Since XAS is an element specific technique, it is very well suited to probe doped nanocrystalline systems since comprehensive information about the local structure of the sample both at the host and dopant sites can be obtained by EXAFS. XANES, on the other hand gives unambiguous information regarding the oxidation state of the dopants in the host matrix and also gives indication of the different vacancies present in the samples. For example, thin films of ZnO with different Mn doping concentrations have been deposited by r.f. sputtering technique. Mn K edge XANES measurements and simulations (left top and bottom panels) confirm the presence of Mn in +2 oxidation state and substitutional Mn and Zn vacancy ($Mn_{Zn}+V_{Zn}$) or substitutional Mn and oxygen vacancy ($Mn_{Zn}+V_O$) in the samples. O K edge XANES measurements and simulations (middle top and bottom panels) rule out the possibilities of $Mn_{Zn}+V_{Zn}$ in the samples. The remaining possibilities are either substitutional Mn and oxygen vacancy ($Mn_{Zn}+V_O$) or only substitutional Mn (Mn_{Zn}). The confirmation of role of oxygen vacancy is done by depositing a sample under excess O_2 which shows lower magnetisation compared to the sample deposited under normal ambient (right panel). Further magnetic measurements show room temperature ferromagnetism found in the samples at lower Mn doping concentration is destroyed at higher Mn doping concentration of ~10%. The above results undoubtedly conclude that magentisation in Mn doped ZnO is defined by two competitive processes viz., ferromagnetic ordering (FM) by oxygen vacancy mediated interaction between Mn ions and anti-ferromagnetic ordering (AFM) in Mn clusters.