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2nd International Conference on

MAGNETISM AND MAGNETIC MATERIALS

September 24-26, 2018 | Budapest, Hungary

Mater Sci Nanotechnol 2018, Volume 2

# CORRELATION BETWEEN THE ELECTRONIC STRUCTURES AND MAGNETIC PROPERTIES OF XE AND AR IONS IMPLANTED ZNO

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A strong correlation between the electronic structures and magnetic properties of unimplanted ZnO single crystal (ZnO-SC) and xenon ($Xe_{3+}$)/argon ($Ar^{+}$) ions implanted ZnO SCs has been investigated using x-ray absorption near edge structure (XANES) spectroscopy, valence band photoemission spectroscopy (VB-PES), x-ray photoelectron spectroscopy, ultraviolet photoelectron spectroscopy, and a superconducting quantum interference device-type magnetometer. The XANES studies reveal the higher number of unoccupied p-states in implanted ZnO SCs than pristine ZnO SCs. The enhancement in the absorption intensity of the XANES spectra of implanted ZnO represents the enhanced local density of states (DOS) that arise from the surface defects or dangling bonds in ZnO. In implanted ZnO SCs, the binding energy of the Zn $2p_{3/2}$ core level peak shifts, which further confirms an increase in the valence band maximum (VBM) position. The VB-PES spectra clearly change upon ions implantation, becoming broader, implying the induced surface defects in ZnO-SC. VB-PES study also reveals that the number of electrons in the valence band of the O 2p–Zn 4sp hybridized states of the implanted ZnO is higher than in the pristine ZnO. The magnetic M–H loops demonstrate an enhanced room temperature ferromagnetism (RT-FM) in Xe/Ar ions implanted ZnO SCs, which is attributed to the increasing number of surface defects and/or native defect sites such as oxygen vacancies and zinc interstitials. This increased RT-FM is strongly related to the enhancement of VB-DOS of O 2p states close to Ef, because the population of defects and/or vacancies at the O sites in irradiated ZnO is higher than pristine ZnO, which is confirmed from VB-PES as well as UPS studies. This study confirms an enhanced room temperature ferromagnetism in Xe/Ar ions irradiated ZnO-SC without ant transition metal doping which could be used in different electromagnetic applications.