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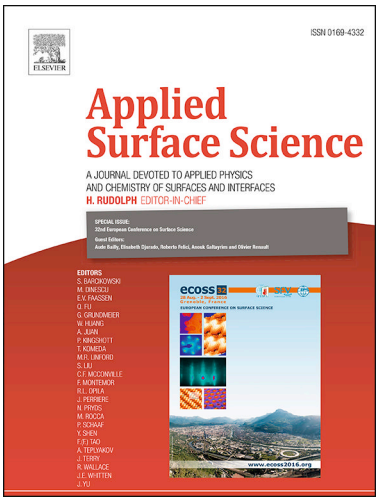

Full Length Article

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Magnetic and Electronic Structures of Co Ion Implanted CeO_2 Thin Films

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Abstract

Present study reports an enhancement of room-temperature ferromagnetism by Co ion implantations in CeO_2 thin films and these Co ions exist in divalent state. These films were deposited on Si (111) substrates using the RF sputtering method. The X-ray diffraction and Raman measurements confirmed the FCC structure corresponding to phase of CeO_2 in these films. The Raman studies also show the presence of defects mainly of oxygen vacancies. The Rutherford backscattering spectrometry shows the thickness of the films as 300nm and also the presence of Co ions in the implanted films. From the Atomic Force Microscopy, it is found that the surface roughness of the films is modified after Co ion implantation. While the magnetic measurements exhibit an increase in the saturation magnetization from ~7 to 21 emu/cm^3 after Co ion implantation at the fluence of 6×10^{16} ions/cm^2, the coercivity value is found to decrease. The Ce ions exhibit both trivalent and tetravalent states as confirmed by X-ray photoelectron spectroscopy measurements. The enhancement in the ferromagnetic properties of these films after Co ion implantation is directly correlated magnetic Co ions, oxygen vacancies and the amount of Ce^{3+} ions. The oxygen vacancies based F-Center exchange model is discussed to understand the enhancement of ferromagnetism in these films.

Key words

CeO_2, ferromagnetism, X-ray photoelectron spectroscopy, RBS, Ion implantation