Transparent Conducting ZnO with (Fe, Ni, V) Magnetic Impurities

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Wide band gap ZnO is well known as a transparent conducting oxide (TCO), very interesting and promising material for transparent electronics [1]. Aim was to look if doping of ZnO by magnetic impurities could add the additional attractive feature to this not expensive TCO, potentially interesting for application in transparent electronics. We combined cheap deposition technique, cheap amorphous substrates and low deposition temperature with attractive properties of this material.

ZnO thin films doped with 1% (Fe, Ni and V) have been grown by spray pyrolysis technique on glass, and fused silica substrates in order to study both effects of magnetic impurity and substrate material on structural, optical and electro-magnetotransport properties of this TCO.

The polycrystalline films have different growth orientation according to the substrate, though in both of cases films are highly transparent (T≈ 85%) in VIS and NIR region of wavelength. Ni and Fe doped ZnO layers are paramagnetic, while V doped exhibits weak ferromagnetic signal. Resistivity versus temperature has semiconducting behavior, activation of conductivity was estimated between 57-140meV. Carrier mobility and concentrations have been determined from Hall Effect. Magnetoresistance at 80K and 300K shows different signs and values depending on the magnetic impurity and substrate. Non ordinary large value of magnetoresistance at 300K at 1.3 Tesla: MR=56% for 1%Fe doped ZnO and MR=28% for 1%Ni doped samples on glass have been observed [2].These exceptional values of MR at room temperature originate probably from the nature of hopping conductivity between crystallites. Effect of grain size and nature of grain boundaries on physical properties in ZnO based materials was already reported [3].

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