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TRANSPORT, MAGNETIC AND THERMAL PROPERTIES OF $(Fe_{100-X}V_X)_{75}P_{15}C_{10}$ SEMI-AMORPHOUS RIBBONS

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$(Fe_{100-x}V_x)_{75}P_{15}C_{10}$ [x=1.5, 3, 9 and 15] semi-amorphous alloys (partially crystalline) in the form of ribbon were prepared by the standard melt spinning technique and studied their transport, magnetic and thermal properties. The nature of the as prepared samples was studied by x-ray diffraction (XRD). The resistivity of the samples was investigated from temperature 93K to 800 K. The resistivity followed 'Mooij Correlation' at low temperature (93 K-300 K). The resistivity at higher temperature (300 K-800 K) remained constant upto a certain temperature and then decreased with temperature rise. The Hall resistivity and the magnetoresistance (MR) were measured in an applied magnetic field upto 0.6 T at room temperature (RT=300 K). Anomalous Hall effect was observed in the Hall resistivity measurement and MR was found to vary 0-8%. The saturation magnetization gradually decreases with the increase of the substitution of Fe by V at RT. Both the impedance magnitude and phase angle remained constant upto 10^6 Hz and then remarkably increased with frequency. The thermal properties associated with crystallization temperature and weight changes were measured by using the differential thermal analyzer (DTA) and the thermo gravimetric (TG) techniques respectively.

Keywords : XRD, Resistivity, Hall resistivity, MR, Magnetization, Impedance, DTA.

1. Introduction

For the last few decades metallic glasses were studied extensively due to their unique mechanical, thermal and magnetic properties [1-4]. Iron-based glassy alloys have been used in many electrical devices such as magnetic wires, sensors, band-pass filters, magnetic shielding and energy-saving electric power transformers [5-7] due to their satisfactory soft magnetic properties. Isotropic and anisotropic spin scattering mechanism should contribute to the resistivity and anomalous Hall effect in magnetically ordered amorphous metals [8-11]. For the scattering centers magnons, magnetic impurities and topological spin disorder had been proposed [8, 11, 12]. In many cases, the structural disorder of the atomic sites was projected onto the spin lattice [9, 13] thus introducing a magnetic scattering contribution to the resistivity aside from thermal excitations. However, this contribution was found to be small in most cases [9, 11, 14]; apparently, anisotropic scattering was a sensitive tool to identify spin scattering contributions in amorphous metals [8, 12, 15]. Mooij [16] pointed out a correlation of the electrical resistivity (ρ) and its temperature coefficient of resistivity (TCR=1/ρ×dρ/dT) at low temperature in metallic alloys. Mooij observed that TCR changes sign in a relatively narrow range of resistivity (i. e., the critical resistivity for which TCR=0, $\rho_c \approx$ 100-160 μΩ-cm). For ρ>160 μΩ-cm, the ρ usually decreases as temperature T increases, in contrast to the normal metallic behavior seen for lower ρ systems. Most theoretical approaches to the Mooij correlation are based on quantum-mechanical coherence effects, namely, the incipient Anderson localization [17]. It has been argued that the breakdown of the adiabatic approximation, leads to phonon-assisted tunneling and, therefore, to a negative TCR. The magnetic properties of the transition elements are critically dependent on fine details of the electronic structure of the d-electrons.

Within Stoner's model for ferromagnetism [18], the effective moment of an iron atom in metallic iron and in iron alloys is mainly due to the effective spins of the 3d electrons. In general the orbital

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