

Electrical conductivity and dielectric behaviour of manganese and vanadium mixed oxide prepared by conventional solid state method

ABSTRACT

Investigation on electrical conductivity and dielectric properties of manganese (Mn) and vanadium (V) mixed oxides were carried out to study the extrinsic semiconductor behaviour. The XRD pattern shows that Mn–V oxide is multiphase and quantitative phase analysis was performed to determine the relative phases. Overall results indicate that with increasing temperature, the DC conductivity, AC conductivity, dielectric constant, dielectric loss factor and loss tangent of Mn–V mixed oxide increases. Activation energy of AC conduction decreases with increase in frequency, confirms that the hopping conduction is the dominant mechanism. The activation energy of DC conduction ΔE_{dc} is 0.54 eV which is greater than ΔE_{ac} . There are three types of dielectric constant spectrum found in the measuring temperature range 30–250 °C. This is possibly due to the extrinsic behaviour of the Mn–V oxide. Dielectric relaxation characteristic was obtained from the spectrum of the imaginary part of electric modulus. The activation energy of the relaxation process and the relaxation time at infinite temperature are 0.42 eV and 5.40 ps respectively. The Nyquist plot of complex impedance fitted the equivalent circuit model of two RC circuits in series with R and C in parallel. The relaxation time was estimated from the circuit model.

Keyword: Dielectric properties; Electrical conductivity; Semiconductor; Manganese oxide; Vanadium oxide