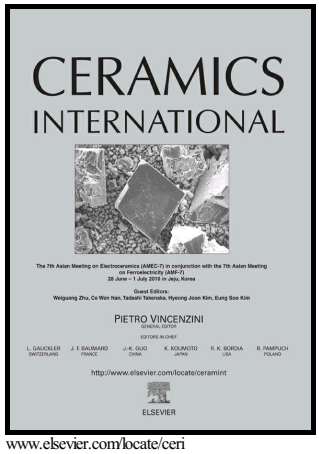

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Temperature dependence of the dynamic electrical properties of $Cu_{1+x}Mn_{1-x}O_2$ (x=0 and 0.06) crednerite materials

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Abstract

Polycrystalline samples of $Cu_{1+x}Mn_{1-x}O_2$ (x=0 and 0.06) have been obtained by solid state reaction in silica tubes. Measurements of complex impedance ($Z=Z'+iZ''$) at various temperatures *T*, between 30 ^{0}C – 120 ^{0}C and over the frequency range 100 Hz – 2 MHz were performed. The frequency dependence of *Z''(f)* exhibits a maximum which moves towards higher frequencies by increasing the temperature, proving thus the hopping of the charge carriers between the localized states is the dominant mechanism for the electrical conduction in the investigated samples. The barrier energy values were: 0.287 eV for $CuMnO_2$ and 0.208 eV for $Cu_{1.06}Mn_{0.94}O_2$.

The conductivity spectrum, *σ(f)* follows the Jonscher universal law at each constant temperature. Based on the temperature and frequency dependencies of the electrical conductivity and using the variable-range-hopping (VRH) model, the frequency and temperature dependencies of the density of localized states near the Fermi level, $N(E_F)$, the hopping distance, *R* and the hopping energy, *W* were computed. The results show that at constant frequency, $N(E_F)$ does not depend on temperature for both samples. At constant temperature and frequencies up to 30 kHz, increasing the concentration of Cu ions leads to the decrease of *R* and *W*, whilst at high frequencies (over 100 kHz), *R* and *W* increase with the increase in the concentration of Cu ions.

Keywords: Crednerite; Complex impedance; Electrical conductivity; Activation energy