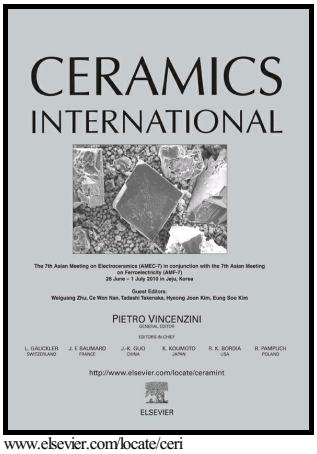

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Influence of Mn doping on electrical conductivity of lead free $BaZrTiO_3$ perovskite ceramic

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Abstract

Mn doped barium zirconate titanate lead free ceramic with formula $BaZr_{0.045}(Mn_xTi_{1-x})_{0.955}O_3$ for x = 0.00, 0.01, 0.02 and 0.03 has been prepared by solid-state reaction method. The single phase tetragonal structure was confirmed by X-ray diffraction (XRD) pattern using Rietveld refinement. Scanning electron microscopy (SEM) shows an inhomogeneous distribution of randomly oriented grains with some voids. Electrical conductivity of Mn doped BZT ceramics was studied using impedance analyzer in the temperature range 493K-673K over wide frequency window. The dispersion behavior in electrical conductivity obeys Jonscher's double power law for Mn free compound, while it follows single power law for Mn doped compositions. Various parameters viz. dc conductivity (σ_{dc}), pre-exponential factor (A), frequency exponent (s) and activation energy (E_a) have been estimated by the theoretical fitting of experimental data. The reciprocal temperature dependence of dc conductivity follows the Arrhenius law and specifies thermally activated conduction mechanism. The obtained value of activation energy (E_a) evidences the conduction mechanism is induced by the migration of oxygen vacancies and oxide ions. All samples shows Negative temperature coefficient of resistance (NTCR) and hence exhibit semiconducting behavior. The environmental friendly lead free ceramic can be exploit to design advanced materials and suitable for the fuel cell electrolyte/electrode applications.