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Electrical investigations of PbTiO3 ceramics with Pb/Ti contents fabricated through solid state sintering reaction method

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Polycrystalline $PbTiO_3$ ceramics were fabricated through solid state sintering reaction method at Pb/Ti molar ratio of x=1.00, 0.98 and 0.94. Keeping the technological position of $PbTiO_3$ ceramics for variety of applications; electrical investigations of crack free sintered $PbTiO_3$ ceramics were struggled under varying processing parameters in the wide spread spectrum of temperature from 40-700 °C at 1k Hz frequency. Stoichiometry and sintering regime strongly influenced the phase transition (TC) of $PbTiO_3$ ceramics; compositions-1.00 and 0.98 showed sharp phase transition predominantly at 490°C. Impedance spectroscopy revealed dielectric anomalies with a relaxor like behavior at higher temperatures. The temperature dependence of alternative current conductivity (σac) confirmed the presence of ferroelectric to para-electric phase transition. At room temperature, resistivity (ρ25) increased with increasing titanium contents. All specimens showed semiconductor behavior with Negative Temperature Coefficient of Resistivity (NTCR) characteristics; expanding drift mobility, μd through increasing temperature concerted the rise in conductivity. The bulk conductivity followed the Arrhenius law with E_a=2.3265-2.6269, 0.8302-0.7246 and 1.7665-0.3889 eV which can be attributed to the ionic conduction governed by V''_{Pb}, $V'O$ and $V''O$ vacancies. Dielectric studies at $PbTiO_3$ ceramics fabricated with optimal 0.98 compositions have potential application for high temperature applications.

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