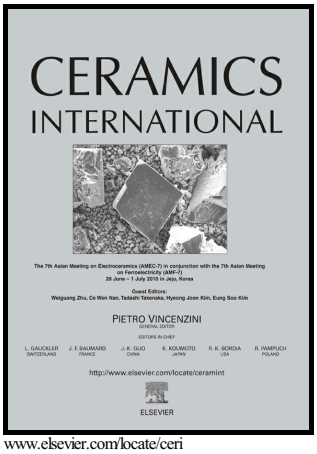
Distribution of relaxation time in solution-processed polycrystalline CZTS thin films: study of impedance spectroscopy

Ayantika Khanra, R.N. Gayen



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Distribution of relaxation time in solution-processed polycrystalline CZTS thin films: study of impedance spectroscopy

Ayantika Khanra[$] and R. N. Gayen[*]

Department of Physics, Presidency University, 86/1, College Street, Kolkata 700073, India

Abstract

Here we report the complex impedance spectroscopic analysis of polycrystalline CZTS thin films synthesized by sol-gel spin coating technique without any post deposition sulphurization. The films are characterized by microstructural, compositional, optical and electrical studies to confirm the formation of kesterite phase of CZTS comprises of well distributed compact grains with the optical band gap 1.44 eV. Room temperature electrical characterizations of the CZTS thin films by four-probe and Hall effect technique revealed the p-type conductivity of the films with resistivity ~ 1.45 x 10^{-2} Ω·cm , mobility ~ 3.7 x 10^{3} $cm^2V^{-1}s^{-1}$ and carrier concentration ~ 1.82 x 10^{17} cm^{-3}. The distribution of relaxation time (DRT) function with improved frequency resolution is reconstructed from the impedance spectra of CZTS film recorded in the frequency range 50Hz-5MHz at room temperature to identify the number of electrical processes in the polycrystalline film. The Nyquist plot is fitted into electrical model consist of three parallel combinations of resistor (R) and capacitor (C) in series as three major peaks in DRT function indicates the presence of different relaxation processes with major contributions from core grains along with smaller contributions from grain boundary and interfaces. The room temperature frequency dependence of dielectric constant, loss tangent and ac conductivity is also studied for the CZTS films.

Keywords: CZTS; sol-gel; thin film; impedance spectroscopy

*Corresponding author. Email: rabin.physics@presiuniv.ac.in ; [$]Present Address: Department of Physics, Indian Institute of Science, Bangalore, Karnataka, 560012, India