UNIVERSITI TEKNOLOGI MARA

UNDERSTANDING THE CRYSTAL STRUCTURES, DIELECTRIC AND OPTICAL PROPERTIES OF Sr_2CaTeO_6, $SrLaLiTeO_6$, $SrLa_{1-x}Nd_xLiTeO_6$ AND $SrLaLiTe_{1-x}Mn_xO_6$ DOUBLE PEROVSKITES

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ABSTRACT

The research carried out for this thesis has concentrated on double perovskite materials Sr_2CaTeO_6, $SrLaLiTeO_6$, $SrLa_{1-x}Nd_xLiTeO_6$ (x=0.25, 0.50, 0.75) and $SrLaLiTe_{1-x}Mn_xO_6$ (x=0.02, 0.04, 0.06, 0.08, 0.10) have been successfully prepared through conventional solid-state procedures. The single–phase monoclinic $P2_1/n$ structure was determined from structural study for both Sr_2CaTeO_6 and $SrLaLiTeO_6$ compounds. The morphological study exhibited an increase of grain sizes when the dopant is added until the maximum grain sizes achieved at concentrations of x=0.50 and x=0.08 in Nd– and Mn–doped $SrLaLiTeO_6$, respectively. Pertained to this results, this study demonstrated the enhancement of grain capacitance values from 0.61 nF in $SrLaLiTeO_6$ at ambient temperature to 2.55 nF in x=0.25 concentration of Nd dopant and the best capacitance achieved is 2.84 nF in x=0.08 concentration of Mn dopant at the same temperature. These capacitance values indicated potential capacitor applications. The impedance study discovered unexpected transition of positive temperature coefficient resistance (PTCR) to negative TCR behaviour in $SrLaLiTeO_6$ and its doped compounds indicated intriguing electrical nature which is one of novelties in this work. These electrical behaviours might be attributed to the free electrons which facilitated in both long–range and short–range conduction mechanisms. Meanwhile, AC conductivity in these compounds can be related to Jonscher's universal power law. The presence of polarons in $SrLaLiTeO_6$ and majority of its doped compounds can be illustrated by temperature facilitated small polaron hopping (SPH) mechanism over a range of temperatures. The optical study revealed the smallest optical bandgap (E_{opt}) by applying Tauc allowed, indirect transition mechanism at x=0.50 concentration of Nd–doped $SrLaLiTeO_6$ with 2.96 eV and at x=0.10 concentration of Mn–doped $SrLaLiTeO_6$ with 0.50 eV which implying semiconductor behaviour. The interesting decrease of E_{opt} in Mn–doped $SrLaLiTeO_6$ was suggested originated from the rearrangement of energy states of Mn^{6+} attributed to Jahn–Teller distortion. Together with these results, absorption region within ultraviolet and visible light range wavelength in Nd–doped and Mn–doped $SrLaLiTeO_6$, respectively indicated potential optoelectronics applications. Overall, the doping B–sites of $SrLaLiTeO_6$ successfully obtained the best results and best novelty results in terms of discovery of PTCR to NTCR transition, enhancement of capacitance values and lowering of E_{opt} values through different mechanisms for each achievement.

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