Thermal, Optical and Electrical Characterization of Silver Tetraiodomercurate Polymeric Composite

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Use of composite materials with polymeric matrices has increased over time, looking for materials with enhanced thermal and electric properties. Polymeric matrices can also help to stabilize filler materials that tend to degrade easily. This work reports the manufacturing and thermal, electric, and optical characterization of composites made of silver tetraiodomercurate (Ag_2HgI_4) powder embedded in a polyester resin matrix. Silver tetraiodomercurate is a thermochromic material that exhibits a discontinuous thermally induced phase transition with changes in its physical properties. At room temperature, silver tetraiodomercurate is in the stable β phase with a tetragonal lattice structure, exhibiting a yellow color; above 323 K, the material changes to the disordered α phase with a cubic lattice structure with an orange color. Ag_2HgI_4 is designated a superionic conductor because its electrical conductivity is similar to those measured in molten salts at its high-temperature α phase. The concentration of Ag_2HgI_4 in the composite varied from 1 to 4 wt%. The hysteresis loop of the thermal diffusivity was measured in a temperature range of 20 to 70 °C using a modified Angstrom method setup. The heating and cooling processes show that the reversible phase transition occurs gradually. Thermal diffusivity decreases by 50% on average during the phase transition. To complement our studies, the electrical conductivity, as a function of temperature, was measured using a two-point probe method. Additionally, UV-Vis spectroscopy shows the band gap shift provoked by the phase transition. The herein-reported composites' properties open their possible applications as temperature sensors and electrical switches due to their reversibility and stability during several working cycles.