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ADVANCEMENTS IN THE QUANTIFICATION OF THE CRYSTAL STRUCTURE OF ZNS MATERIALS PRODUCED IN VARIABLE GRAVITY

Abstract

Screens and displays consume tremendous amounts of power. Global trends to significantly consume less power and increase battery life have led to the reinvestigation of electroluminescent materials. The state of the art in ZnS materials has not been furthered in the past 30 years and there is much potential in improving electroluminescent properties of these materials with advanced processing techniques. Self-propagating high temperature synthesis (SHS) utilizes a rapid exothermic process involving high energy and nonlinearity coupled with a high cooling rate to produce materials formed outside of normal equilibrium boundaries thus possessing unique properties. The elimination of gravity during this process allows capillary forces to dominate mixing of the reactants which results in a superior and enhanced homogeneity in the product materials. ZnS type materials have been previously conducted in reduced gravity and normal gravity. It has been claimed in literature that a near perfect phases of ZnS wurtzite was produced. Although, the SHS of this material is possible at high pressures, there has been no quantitative information on the actual crystal structures and lattice parameters that were produced in this work. Utilizing this process with ZnS doped with Cu, Mn, or rare earth metals such as Eu and Pr leads to electroluminescence properties, thus making this an attractive electroluminescent material. The work described here will revisit the synthesis of ZnS via high pressure SHS and will re-examine the work performed in both normal gravity and in reduced gravity within the ZARM drop tower facility. Quantifications in the lattice parameters, crystal structures, and phases produced will be presented to further explore the unique structure-property performance relationships produced from the SHS of ZnS materials.