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Optical Properties of CsI:Tl Crystals Grown Using Different Precursors Purities

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CsI doped with Tl (CsI:Tl) is a scintillator material used for radiation detector applications. CsI:Tl was crystalized by a modified homemade Bridgman-Stockbarger technique using different precursor purities. The purpose is to verify effects of precursor purity on optical properties of Cs:Tl crystals by UV-VIS and X-ray luminescence spectroscopy. A concentration of impurities in the precursor is directly related the optical properties of CsI:Tl crystals. The CsI:Tl crystals were grown in two levels of CsI and TlI reactant materials, i.e., having as a very high purity of 99.999 %, showing a colorless crystal and a high purity of 99.9 % showing an orange crystal. Absorption coefficient determined by transmittance and reflectance spectra was used to find an optical gap in the CsI:Tl crystals. For colorless crystal, optical gap of the Tl-related state and the CsI bandgap, which were located at 3.5-3.8 eV and 5.0-5.2 eV, respectively, was observed. On the other hand, a merging of Tl-related state and CsI bandgap was observed for the orange crystal. Also, X-ray luminescence spectra centered at around 2.0 to 2.5 eV showed a red shift for the orange crystal. These results indicated effects of precursor purity on optical gap of the CsI: Tl crystal.

Author: Mr SINTHAM, Poramin (Department of Physics, Faculty of Science, Chulalongkorn University, Bangkok 10330,)

Co-authors: Dr SANORPIM, Sakuntam (Department of Physics, Faculty of Science, Chulalongkorn University, Bangkok 10330,); Dr SAENGKAEW, Phannee (Department of Nuclear Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand)

Presenter: Mr SINTHAM, Poramin (Department of Physics, Faculty of Science, Chulalongkorn University, Bangkok 10330,)

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