Ternary cesium lithium iodide crystals grown by vertical Bridgman method for scintillation applications

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Recently, due to the ongoing worldwide He shortage, the ^{3}He detectors have become prohibitively expensive. Thus, search for new neutron and scintillation detectors meeting present and future challenges is of high demand. For instance, a replacement of ^{3}He detector and similarly widely used scintillators (e.g. NaI:Tl, CsI:Tl) would require to fulfill low-cost, solid-state, and potential to be mass-produced from readily available materials and technology [1]. Such demands could be fulfilled by ternary alkali halides such as $Cs_2Li_3I_5$ (CLI), which exhibit light yield of ca. 40,000 to 55,000 photons/neutron, primary decay time of 250 ns for thermal neutron interactions and 500 ns for gamma rays, and when doped with Eu emission maxima peaking at ca. 450 nm [1].
According to CsI-LiI phase diagram presented by Sangster and Pelton [2] no ternary phase is present, though, its formation ($Cs_2Li_3I_5$) was already confirmed by Meyer and Gaebell in [3]. However, preparation of large CLI single crystals was not published so far. Reportedly, its crystals were synthesized by direct melting of CsI:LiI mixture of stoichiometric ratio 2:3 in sealed ampoule and cooled to room temperature obtaining small size crystals [2,3].
The goal of this work is to prepare single crystals of ternary CLI, confirm its phase purity and perform basic structural, physical, thermal, optical, luminescence, and scintillation characterizations. Further aim is to analyze the influence of doping of monovalent ions (e.g. In, Tl) in the matrix on its luminescence properties.

References (if needed)

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