Growth and characterization of zirconium-doped cesium hafnium chloride crystals for scintillators

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Currently, cesium hafnium chloride (Cs_2HfCl_6) has been widely studied for its promising scintillation properties. Due to its high light yield up to 54,000 ph/MeV, energy resolution of 2.8 % at 662 keV, scintillation response of 4.4 us (95 % of energy) at 662 keV, density of 3.86 g/cm^3 [1], and low hygroscopicity, it is considered for possible application as a new cost effective scintillator for gamma ray spectroscopy. The scintillating mechanism in the undoped Cs_2HfCl_6 is ascribed to intrinsic luminescence originating in a self-trapped excitons represented by a V_k center [3]. Furthermore, an influence of nonstoichiometry on the magnetic properties was reported as well [4]. The Cs_2HfCl_6 is formed by cesium chloride and hafnium chloride mixed together in stoichiometric ratio 2:1 congruently melting at ca. 821°C [5]. The Cs_2HfCl_6 crystallizes in cubic structure with lattice parameters a = 10.42 $\pm$ 0.01 Å (space group Fm-3m).

This work is aimed on the preparation of starting materials (CsCl, $HfCl_4$), synthesis of Cs_2HfCl_6, doping of Cs_2HfCl_6 by tetravalent elements A^{4+} (such as Zr^{4+}), and growth of Cs_2HfCl_6:Zr^{4+} crystals by the vertical Bridgman method. Prepared crystals were cut and polished for subsequent examination concerning their physical, structural, optical, luminescence, and scintillation properties.

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