Crystal growth of pure and Sn-doped SrI₂ by atmosphere-controlled micro-pulling-down method and its luminescence and scintillation properties

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Recently, there has been growing interest in the search for new scintillation materials with fast and efficient response to X-ray and γ-ray radiation and emitting in visible or UV light. Rapidly developing medical imaging techniques, homeland security monitoring, and other fields require materials with extremely high energy resolution. These requirements can be fulfilled by strontium iodide (SrI₂) doped with Eu⁴⁺ which has high light yield of 83,000 MeV and excellent energy resolution below 3% at 662 keV. However, the contemporary material concept is based on heavy doping (5%) of SrI₂ by one of the most expensive and most critical RE elements, namely Eu⁴⁺ ion. Moreover, small Stokes shift resulting in reabsorption of Eu⁴⁺ emission is a serious problem in larger size scintillation elements and degrades both timing and energy resolution characteristics. Thus, search for new doping elements in SrI₂ such as the s²⁻-ion group (e.g. Sn²⁺) with suitable luminescence properties is required.

Strontium iodide is a congruently melting compound with melting point at 515 °C and orthorhombic crystallographic structure. But its high hygroscopicity and affinity to atmospheric moisture lead to formation of hydroxiodides and make preparation of high purity and quality SrI₂ single crystals difficult. These oxidic impurities must be removed from SrI₂ starting material before its crystal growth.

This work deals with preparation of SrI₂ starting material, its doping by Sn²⁺ ion, and crystal growth by the atmosphere-controlled micro-pulling-down (μ-PD) method. Basic optical, luminescence, and scintillation properties of the prepared single crystals will be presented and discussed. Crystal growth, sample processing, and their handling was performed under protective oxygen-free atmosphere throughout all manufacturing process. To the best of our knowledge, preparation and crystal growth of Sn-doped SrI₂ single crystals by the μ-PD method has not been published so far.

Acknowledgement

This work was supported by the research projects: (i) MSMT KONTAKT II no. LH14266, (ii) by Grant-in-Aid for JSPS Postdoctoral Fellowship for Foreign Researchers (P14040), (iii) ASCR Bilateral Joint Research Projects, (iv) Development of Systems and Technology for Advanced Measurement and Analysis (SENTAN), Japan Science and Technology Agency (JST), and (v) Adaptable and Seamless Technology Transfer Program through Target-driven R&D (A-STEP), JST.