Crystal growth and characterization of $Cs_4Mg_3F_{10}$ prepared by the micro-pulling-down method

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The demand for so-called “ultrafast scintillators” for applications including time-of-flight positron emission tomography (TOF PET) and high energy physics (HEP) renewed interest in cross-luminescence (CL) scintillators [1]. A recent study of cesium-based ternary chlorides has shown the potential of cesium-based CL scintillators for fast-timing applications [2]. However, the development of a fluoride-based CL scintillator is necessary to achieve better photon detection efficiency. This was a motivation for the exploration of the ternary compounds from the CsF-MgF_2 phase diagram.

In contrast to the published phase diagram [3] we were not able to grow $CsMgF_3$ single crystal. However, the growth of a single crystal with stoichiometry $Cs_4Mg_3F_{10}$ by the micro-pulling-down method was successful. Although, its crystal growth was complicated primarily due to high evaporation of the CsF from the melt caused by its overheating.

Based on the result of X-ray powder diffraction we suggest that the $CsMgF_3$ phase is not stable and the $Cs_4Mg_3F_{10}$ and Cs_2MgF_4 are the only stable ternary phases in the CsF-MgF_2 phase diagram. The crystal structure of $Cs_4Mg_3F_{10}$ (orthorhombic, space group no. 64) consists of alternating chains of three MgF_6 face-connected octahedra separated by Cs^+ ions [4].

The optical properties of $Cs_4Mg_3F_{10}$ were thoroughly investigated using absorption, photoluminescence, radioluminescence, photoluminescence and scintillation decay kinetic as well as photoelectron to reveal whether $Cs_4Mg_3F_{10}$ exhibit CL.

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