SYNTHESIS AND OPTICAL PROPERTIES OF Mn^{5+} -DOPED $Sr_5(PO_4)_3F$

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As technologies are advancing, demand for new chemical materials is increasing. Part of the materials of interest are optically active materials, which usually consist of host matrix and dopant – optically active ion. For example, these materials can be used for a wide range of applications, including luminescence thermometers or manometers, lasers, LEDs, or even biomedicine, etc. One of the suitable host materials can be strontium fluorapatite ($Sr_5(PO_4)_3F$; SFAp). Because of alkaline strontium properties and the presence of P^{5+} ions in the structure, SFAp can adopt and stabilize optically active Mn^{5+} ions, which are usually unstable under normal conditions. Mn^{5+} ions have a wide excitation range, including the NIR-I region as well as intense emission in the NIR-II range. Due to the mentioned properties, Mn^{5+}-doped strontium fluorapatite is a promising material to use in many applications such as luminescent thermometry, NIR lasers, or biomedicine.

The main goal of the present work was to synthesize Mn^{5+}-doped SFAp powders and investigate their optical properties. Synthesis was performed in two steps. Firstly, strontium nitrate ($Sr(NO_3)_2$), diammonium hydrogen phosphate ($(NH_4)_2HPO_4$) and ammonia ($NH_{3(aq)}$) were used for wet-precipitation synthesis of strontium phosphate ($Sr_3(PO_4)_2$). Secondly, $Sr_5(PO_4)_3F$ powders doped with various amounts of Mn^{5+} ions were obtained by molten salts method using $Sr_3(PO_4)_2$, strontium fluoride (SrF_2), sodium fluoride (NaF) and manganese (II) nitrate tetrahydrate ($Mn(NO_3)_2 \cdot 4H_2O$) as starting materials. Phase purity and crystal structure of synthesized samples were studied by powder X-ray diffraction (XRD), infrared (FTIR) and Raman spectroscopies. Morphological features of synthesized materials were investigated by scanning electron microscopy (SEM). The chemical composition of the samples was determined by inductively coupled plasma optical emission spectrometry (ICP-OES). Optical properties were investigated by means of photoluminescence measurements: reflectance spectra, excitation spectra, emission spectra, and decay times were measured. Temperature-dependent measurements were performed as well.