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Optical spectroscopy of BaF2:Pb2+ crystals

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The spectroscopic properties of ns^2 ions in alkaline halide crystals are old and well-studied [1]. Regarding the spectroscopic properties of ns2 ions doped in alkaline-earth fluorides, these are less investigated. Few authors [2,3,4] have studied the optical properties of CaF_2:Pb^{2+} crystals and LuAG:Ce single crystalline films. Recently, the effect of gamma irradiation on the PbF_2 doped BaF_2 crystals was reported [5]. The main goal of this paper is to investigate the influence of Pb^{2+} ions on the spectroscopic properties of the BaF_2 crystals.

The various PbF_2-doped BaF_2 crystals were grown using the Bridgman method. The crystals are transparent, colorless, with no inclusions. The samples are cleaved slices along (111) crystallographic plane of about 10 mm in diameter.
Room-temperature UV-VIS absorption spectra were recorded by Shimadzu 1650PC spectrophotometer. Room temperature UV-VIS luminescence spectra and time resolved measurements were recorded using by FLS 980–Edinburgh Instruments spectrofluorimeter equipped with Xe lamp as excitation source.

The Pb^{2+} ions in BaF_2 lattice gives rise to absorption bands in UV domain [1, 2]. The absorption spectra of BaF_2:Pb^{2+} crystals reveal the two absorption bands centered at 203 and 290 nm, respectively. As the concentration increases the shape and intensity of absorption band at 203 nm increases, while the band at 290 nm conserves their sharp shape and width. From the preliminary luminescence measurements, results the same UV-VIS emission spectra for all samples under excitation at 290 nm; the UV emission intensities at 304 and 321 nm depends on Pb^{2+} ions concentration. These bands are attributed to the $^3P_1 \rightarrow {}^1S_0$ transition of Pb^{2+} ion.

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