VUV Response of the Lu_2SiO_5:Ce Scintillator

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The good scintillation properties of Lu_2SiO_5:Ce were first indicated by Melcher and Schweitzer [1,2]. A relatively high light yield /LY/ and a quite fast scintillation decay time (order of 40 ns), together with a large density (7.4 g/cm^3), inspired a study of this material as a fast high-energy radiation detector. The scintillation mechanism was also investigated [3,4].

At the Superlumi station of HASYLAB we have studied the spectroscopic properties of Lu_2SiO_5:Ce. Three pixel samples (2x2x10 mm) of different light yields, grown by Photonic Materials Limited, Scotland, have been examined (*Table 1*). In this report we focus on the VUV excitation of the dominant 400 nm emission (other aspects are discussed in a separate report [5]).

In our earlier reports [6] it has been shown that photoluminescence spectra and time profiles of BaF_2:Ce, BaF_2:Pr, and $LuAlO_3$:Ce, excited at, say, 70-110 nm, emulate well their radioluminescence spectra and time profiles. A similar feature comes out in case of Lu_2SiO_5:Ce, as the emission bands at 70 and 110 nm excitation (*Fig. 1*), dominated by the cerium luminescence from the Ce1 sites [5], are identical with the band observed under X-ray excitation (not shown). Moreover, there are no differences other than in intensities between the spectra of the same kind (i.e. radioluminescence or VUV-excited photoluminescence), measured on our samples.

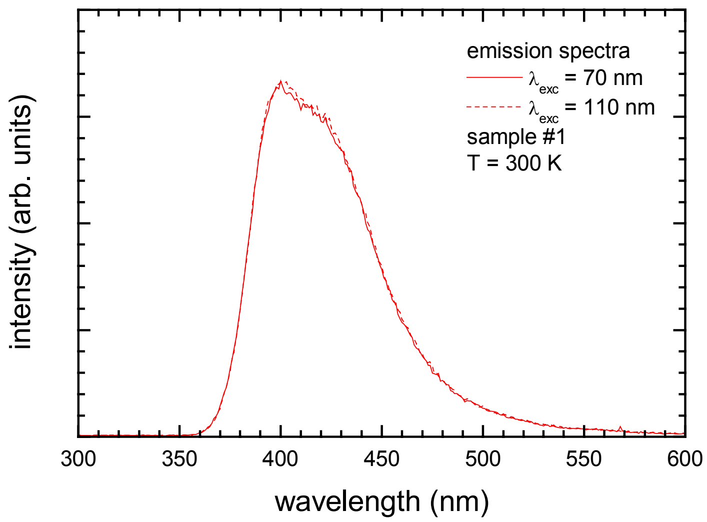

Figure 1: VUV excited emission spectra of LSO:Ce

The excitation spectra of the 400 nm emission are presented in *Fig. 2*. Contrary to the emission spectra, the curves belonging to individual samples differ from each other. The distinctions occur not exactly in the band shapes and positions, which are roughly the same, but in the relative intensities of the bands. It is evident that the 400 nm luminescence can be excited between 50 and 130 nm much more efficiently in the sample denoted as #1 than in the two other ones. Analyzing the results of various experiments we have noticed a correlation of the relative efficiencies of the excitation below 130 nm with the scintillation light yields of the samples. To verify this observation, we have integrated the excitation spectra in two ranges: 50-130 nm (integral I_1) and 130-320 nm (integral I_2). Then we have compared the I_1/I_2 ratios with the corresponding light yields. As shown in *Table 1*, the agreement is quite good. However, in order to propose an empirical formula LY = f (I_1/I_2), more samples should be examined first.

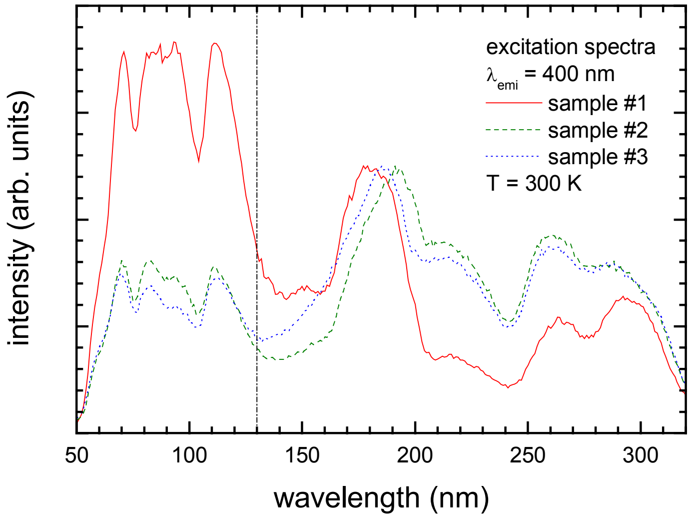

Figure 2: Excitation spectra of LSO:Ce

Table 1: The correlation of the VUV response of LSO:Ce samples with their scintillation light yields

sample	LY (relative units)	I_1 {50-130 nm}	I_2 {130-320 nm}	I_1/I_2
#1	1.00	87.55	88.46	0.99
#2	0.42	38.22	109.70	0.35
#3	0.33	35.38	112.10	0.32

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