UV AND VUV SPECTROSCOPY OF RARE EARTH ACTIVATED WIDE BANDGAP MATERIALS

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The growing interest in UV and VUV spectroscopy of rare earth activated solid state materials is generated by new and demanding applications such as uv and vuv solid state lasers, fast and efficient scintillator materials and "quantum-cutting" phoshors driven by mercury free discharge radiation.

In this Communication we will survey UV and VUV spectroscopy experiments performed at the Superlumi station of Hasylab, DESY, Hamburg, on samples of BaF_2 and $(Ba,La)F_2$ crystals activated with Ce and Er. The experiments include luminescence and luminescence excitation spectra as well as time profiles obtained under selective VUV and UV pulsed synchrotron excitation. We will demonstrate that these experiments reveal some interesting features of these systems that depend both on the peculiar complex characteristics of rare-earth ions as well as the influence of the host material.

In particular we will analyze and compare the excitation spectra of the $5d \rightarrow 4f$ emission in Ce and $4f^{10}5d \rightarrow 4f^{11}$ emissions in Er activated BaF_2 and $(Ba,La)F_2$. The unusual fast and efficient emission from the low spin $4f^{10}5d$ state in $(Ba,La)F_2$ points to significance of the highly lying Er^{3+} $4f^{11}$ levels on the nonradiative and radiative transitions between low and high spin states of the Er^{3+} $4f^{10}5d$ configuration.

We will also analyze the information revealed by the excitation spectra of the Ce^{3+} $5d \rightarrow 4f$ as well as Er^{3+} $4f^{n-1}5d \rightarrow 4f^n$ and $4f^n \rightarrow 4f^n$ emissions on the energy transfer mechanisms from the fluoride host to the rare earth ions. We will demonstrate that the fast energy transfer channels involve free and bound excitons while the generation of the free electrons and holes leads to slow processes dependant on hole and electron trapping.

Eventually we will use the information supplied by UV and VUV synchrotron studies to discuss possible applications of fluorides activated by Ce and Er.