Optical properties of Eu doped YSZ and and Ce³⁺ doped YPO₄

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The focus of our group is mainly directed towards optical characterization of different new and novel ceramic materials considering their excitation pathways and performance. The experiments carried out at Hasylab during 2012 were focused on Eu doped Yttria stabilised zirconia (YSZ:Eu) and Ce³⁺ doped YPO₄ nanocrystals.

YSZ microtubes as a potential nanodevices for drug delivery and luminescent microprobes were investigated with the aim of identifying the luminescent centres present in the samples. According to excitation and luminescence decay measurements, the samples revealed two separate sites with slightly different excitation spectra and different decay dynamics (see figure 1 below).

Results of the research are prepared for a paper report.

The Ce³⁺ doped YPO₄ nanocrystals represented a unique possibility to investigate the effect of water doping in YPO₄ and its effect on the dopant luminescence. We measured the luminescence excitation spectra, the emission spectra and fluorescence kinetics of the 5d¹-4f¹ allowed dipole transition of Ce³⁺ dopant in the in the YPO₄ and the YPO₄-0.8H₂O nanocrystals. Using the measured spectra of luminescence excitation (see figure 2), we determined for the first time the crystal-field splitting of the 5d¹ configuration of Ce³⁺ in the YPO₄-0.8H₂O nanocrystals. Then we calculated the 5d¹ crystal-field splitting using the exchange charge model of crystal field theory developed in [2] and obtained good fit with the experimental results. The crystal-field splitting of the 5d¹ configuration of Ce³⁺ in YPO₄-0.8H₂O is about 1.5 times larger than that in the YPO₄ doped nanocrystals (see figure 2).
Figure 2. The luminescence excitation spectra of the YPO$_4$: 2 mol% Ce$^{3+}$ (curve 1) and the YPO$_4$·0.8H$_2$O: 2 mol% Ce$^{3+}$ nanocrystals (curve 2) are tuned over the 4$f^1$ – 5$d^1$ transitions and detected at the 5$d^1$ – 2$F_{7/2}$ transition of Ce$^{3+}$. The notes on the graph indicate the measured crystal-field levels including reported in Ref [5]. All spectra are detected at $T=10$ K of samples temperature.

These results will be presented on the FM&NT-2013 conference [3] and part of these results have been reported on the ICFE-8 conference [4].

References