THE SYNTHESIS OF EuF₃/TOPO NANOPARTICLES

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Rare Earth Based compounds are well known luminophores due to their characteristic sharp line excitation with high quantum efficiencies, and good photochemical stability in comparison with transition metals. Besides, the possibility to develop phosphors based on Rare-earth fluorides with visible quantum efficiencies higher than 100% upon VUV excitation (called quantum cutting or cascade excitation) is also of particular interest.

However the technical realization of Rare Earth fluoride systems with ultimate quantum efficiencies is usually complicated due to contamination of fluorides by oxygen, which forbids cascade processes because of nonradiative relaxation to the CT-states and emission from these levels. Only a few methods are known to result in formation of pure macrocrystalline fluorides but even such systems quickly degrade at low pressures, high voltages and temperatures of gas-discharge lamps. Furthermore, the adsorption of pure fluorides is very low, so the possibility to use sensibilisation technique is of great interest. While using nanoparticles, it is easy to find convenient ways to make effective sensibilisation for fluoride, the same as nanoparticle technique allows realization of flexible systems by incorporation of particles in polymer matrix.

Here we present novel synthetic method for the preparation of core-shell EuF₃/TOPO (tri-octyl phosphine oxide) nanoparticles. The synthesis was carried out by the decomposition of previously dehydrated flour-containing complex of europium Eu(CF₃COO)₃ with different concentrations in the solution of surfactant at different temperatures. It was found that TOPO shell prevents pyrolysis of fluorides and can transfer emitted energy to fluoride core.

Synthesized nanoparticles can be used as line emission phosphor in orange part of spectrum. Furthermore, using this method to produce sandwich particles EuF₃/GdF₃ or incorporation this nanoparticles into the GdF₃ or LiGdF₄ matrix gives rise to highly promising system for the realization of “quantum cutting” effect with quantum efficiencies up to 200%.