Luminescence of a Photon Cascade Nano-Phosphor

A.A. Setlur, A.M. Srivastava, V. Manivannan, H.A. Comanzo
GE Global Research
Niskayuna, NY 12309
U.Happek, J. Fleniken, P. Schmidt
Department of Physics and Astronomy
University of Georgia
Athens, GA 30602
B.Tissue
Department of Chemistry
Virginia Polytechnic Institute and State University
Blacksburg, VA 24061

We report on the first successful synthesis of a photon cascade phosphor in nanocrystalline form. Nanoparticles of $SrAl_{12}O_{19}:Pr^{3+}$ (SAP) were produced by laser evaporation of polycrystalline ceramic precursors in a nitrogen atmosphere. We report on the synthesis and processing of nano-SAP with structural (TEM, SEM, x-ray diffraction) and optical characterization of this nanophosphor. Initial investigations reveal the characteristic photon cascade luminescence of SAP under VUV excitation. By comparing luminescence spectra and relaxation rates at various temperatures under $4f^2 \rightarrow 4f^15d^1$ and direct $4f^2$ excitation of the nanophosphor with that of bulk SAP, we will determine the influence of the particle size on the branching ratio and both radiative and non-radiative relaxation channels in the nanoscale material. Thermoluminescence will also be used to identify traps specific to the nanophosphor material, which could reflect the large surface to volume ratio of the nanoparticles and/or the synthesis procedure for the material. Finally, all of this information will be integrated to assess the quantum efficiency (visible and total) of SAP nanoparticles.

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