Concentration Studies of the Praseodymium $^3P_0$ Emission in $SrAl_{12}O_{19}:Pr^{3+}$

U. Happek, and P.A. Schmidt
Department of Physics and Astronomy
The University of Georgia
Athens, GA 30602, USA
A.A. Setlur, H.A. Comanzo, V. Manivannan, and
A.M. Srivastava

A.M. Srivastava

GE Corporate Research and Development
Niskayuna, NY 12309, USA

Phosphor materials with a quantum efficiency greater than 100 % have been studied since 1974, when Piper et al. observed quantum cascade emission in $YF_3:Pr^{3+}$ /1/. More recently, Srivastava and Beers reported quantum cascade emission in a Pr^{3+} doped oxide, $SrAl_{12}O_{19}:Pr^{3+}$ (SAP). In this talk we will focus on the concentration quenching of the Pr^{3+} emission in this system by studying the Pr^{3+} luminescence after pulsed excitation for dopant concentrations between 0.1 % and 15 % in the temperature range from 1.5 K to 300 K. While the relaxation of SAP with 0.1 % Pr^{3+} is found to be single exponential, samples with higher Pr^{3+} concentration display the (expected) non-exponential relaxation behavior due to cross relaxation between Pr^{3+} ions in close proximity (Fig. 1).

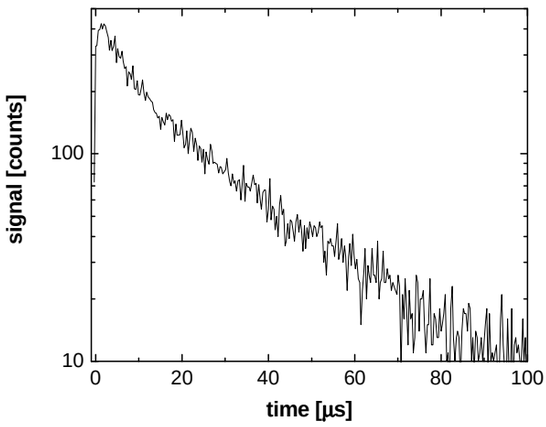

Fig. 1: Semi-log graph of the transient $^3P_0$ – $^3H_4$ luminescence of SAP: 10% Pr^{3+}.

An analysis of the experimental data shows that a large fraction of the Pr^{3+} ions does not participate in cross-relaxation or energy migration processes, and that this fraction consists of those ions that lack another Pr^{3+} at both the nearest and next nearest cation site.
In addition to transient measurements of the Pr^{3+} emission, we have studied the details of the cross relaxation process by analyzing infrared emission spectra of SAP obtained via Fourier transform spectroscopy.

This work has been supported in part by GE and the Department of Energy under contract DE-FC26-99FT40632.

/1/ W.W. Piper, J.A.DeLuca, and F.S. Ham; J. Lumin. 8 (1974) 344.

/2/ A.M. Srivastava and W.W. Beers; J. Lumin. 71 (1997) 285.