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FLUORESCENCE LIFETIME MEASUREMENTS
OF SM:YAG AND POTENTIAL USE AS AN
OPTICAL THERMOMETER

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Fluorescence Lifetime Measurements of Sm:YAG and Potential use as an Optical Thermometer

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In situ phase equilibrium studies require a means of accurate pressure and temperature measurement. Earlier work has demonstrated that the frequency shift of the laser-induced fluorescence of samarium-doped yttrium aluminum garnet, Sm:YAG, can be used without temperature correction as a pressure sensor for high temperature diamond anvil cell experiments. Reported here are the results of preliminary studies on the temperature and pressure dependence of the Sm:YAG fluorescence lifetime and its use as a possible optical thermometer.

The lifetime of laser-induced fluorescence of Sm:YAG was measured as a function of Sm dopant concentration, temperature, and pressure using the phase modulation technique. The Sm dopant concentration was varied between 0.1 to 3.0 % mole fraction Y in crystalline powders prepared from a metal nitrate precursor solution. The temperature dependence of the lifetime was measured between 20 and 1200 °C. For all dopant concentrations, a similar temperature dependence is observed; namely, at low temperature the lifetime is insensitive to temperature and at higher temperature the lifetime decreases sharply. In addition, the temperature at which the lifetime becomes strongly temperature dependent varies with dopant concentration. Preliminary high pressure studies indicate the lifetime of Sm:YAG is relatively unchanged to 40 kbar. These results suggest that the Sm:YAG fluorescence lifetime may be a promising optical thermometer for high pressure experiments and that the region of temperature sensitivity can be "tuned" by varying the dopant concentration.

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