Rare earth ions (RE3+) are highly sensitive to local symmetry. Any change in the symmetry is observable in their luminescence spectra [1]. In this work we investigated the photoluminescence properties of cubic and monoclinic Y₂O₃ matrix, doped with either Eu³⁺ or Sm³⁺ ions, under high pressure.

The high pressure was achieved in a diamond anvil cell (DAC). The cell is transparent and is secured to a microscope with a camera. (Figure 1. a). The pressure was calculated by observing the ruby R1 line shift within the standard methanol-ethanol hydrostatic mixture. (Figure 1. b)

The photoluminescence emission was recorded from 0 to 20 GPa for Sm³⁺ doped cubic Y₂O₃, and from 0 to 15 GPa for Y₂O₃:Eu³⁺. Measurements for the monoclinic matrix were recorded from 0 to 8 GPa for Y₂O₃:Eu³⁺.

The intensity ratio of 5D₀ → 7F₁ and 5D₀ → 7F₂ Eu³⁺ emission lines in the cubic matrix has a similar pressure dependence to the intensity ratio of Sm³⁺ emission lines. The monoclinic Y₂O₃:Eu³⁺ also has a pressure-sensitive intensity ratio of 5D₀ → 7F₁ and 5D₀ → 7F₂ Eu³⁺ emission lines (Figure 3.). The high sensitivity suggests that this dependence can be used as an efficient high pressure sensor.

REFERENCE: