Luminescence and local environment of *f*-elements under pressure

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The luminescence of lanthanide *f*-elements at high pressures is determined by the compression of their bonds and changes in the symmetry of their local environment in the host matrix, which alter the intensity, energy, and lifetime of the emission [1-3]. In addition, a reduction in the volume of the host matrix can lead to phase transitions and, ultimately, to the amorphization of the network. The modification of the local environment occupied by optically active ions, caused by pressure and resulting from the reduction in interatomic distances, in turn increases the crystal-field interaction between the *f*-element and its ligands, as well as the covalent nature of their bonds, due to the increasing overlap of their orbitals. Consequently, the optical response manifests itself primarily in two main ways [1-3]: (i) an energy shift in the absorption and emission lines due to changes in the energy level scheme of the f-element; and (ii) a variation in emission intensity due to competition between radiative and non-radiative (multiphonon plus energy transfer) processes.

The europium (Eu^{3+}) and neodymium (Nd^{3+}) ions are convenient pressure probes because some of their electronic transitions are extremely sensitive to the symmetry of their immediate environment. In this work various examples of the intimate relationship between the local environment and the luminescence of the lanthanide ions is described analyzing in detail the crystal-field interaction in (i) an Eu^{3+}-doped fluorozirconate amorphous glass, (ii) the pressure-induced phase transition in Nd^{3+}-doped $LaVO_4$ crystal, and (iii) the blue and red shifts of the emission lines in Nd^{3+}-doped $YAlO_3$ crystal; and (iv) the energy shift of the emission lines of Nd^{3+} in some garnet crystals, which can be used as pressure gauges.

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