EXAFS Measurements of Nd^{3+}-doped Alkali Silicate Glasses on the Nd K-edge

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Rare-earth doped glasses are important materials for the application to laser glass. The optical process due to the dielectric dipole transition between $4f^N$ states is explained by the Judd-Ofelt (JO) theory. In this theory, three intensity parameters (JO parameters), Ω_t (t=2,4,6), are directly related to the optical properties of rare earth ions, such as stimulated emission cross section and branch ratio. The JO parameters change depending on the amount and species of network modifier as a result of the change in the ligand field symmetry and the covalency.

We have studied the local structure of neodymium ions in comparison with the JO parameters. Recently, we observed in alkali silicate glasses a clear correlation between the JO parameters and the Nd-O distance determined by the L_3-edge-EXAFS measured at the Photon Factory. The energy separation between the L_3- and L_2-edges is, however, as narrow as 500 eV, which limits the analytical resolution. In this study, we have attempted to measure EXAFS on the Nd K-edge (43.571 keV) in order to analyze the local structure in more detail.

White X-ray beam was monochromatized by an Si (311) double-crystal monochromator. The intensity of incident and transmitted X-ray beam was monitored by ionization chambers filled with krypton gas for transmission spectra. For fluorescence detection, the Lytle detector filled with krypton gas was employed. A cerium filter was utilized to eliminate the background mainly due to the elastic scattering.

Figure 1 shows a fluorescence spectrum of a Nd-doped alkali-calcium-silicate glass ($20Li_2O$-$20CaO$-$60SiO_2$:$0.3Nd_2O_3$). A broad hump appears around 44.1 keV. This hump was found to be due to a large dip in the incident beam intensity, which might be caused by some defects in the monochromator. Except for the glitch, however, the fluorescence signals from the Nd-doped glasses were successfully collected.

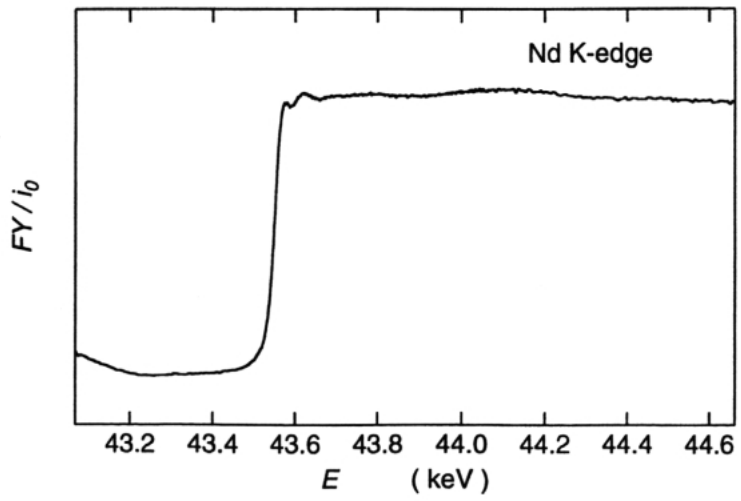

Fig.1
Fluorescence spectrum of $20Li_2O$-$20CaO$-$60SiO_2$:$0.3Nd_2O_3$ glass on the Nd K-edge.