Local Structure of Erbium Doped Glasses Studied with XAFS Measurements

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Erbium doped silicate glass fiber optical amplifiers are promising compornent for optical telecomunications. To control the radiative characters of the device, it is important to develop methods for studying local structure around the doped Er^{3+} ions with specimens of thin fiber and at low dopant levels.

In the present work, we have obtained XAFS spectra of Er_2O_3 mixed with SiO_2 at the L_{III}-edge and K-edge of erbium using fluorescence and transmission methods. A preliminary result on $19SiO_2 - 2Al_2O_3 - GeO_2 : 0.006Er_2O_3$ glass fiber has also been obtained.

Figure 1 shows fluorescence spectra of erbium at the L_{III}-edge with the integration time per data point of 3 seconds. Spectra in figure 1A are obtained from mixed powder samples with three lebels of Er_2O_3 content using a Lytle detector. Since the Er_2O_3 content of our glass sample was much lower than these, it was necessary to use the glancing incidence fluorescence detection technique with an SSD to obtain a spectrum as shown in Figure 1B. Although the spectrum is noisy because of the insufficient integration time, it looks promising.

Figure 2 shows K-edge XAFS spectra obtained from mixed powder samples using the transmission method. Extracted EXAFS spectra are compared in figure 2A. Upper two spectra are obtained at a low temperature. Since these two spectra are almost identical, it is expected that at this high energy only erbium absorbs the photon. This means that XAFS spectra of erbium at the K-edge can be obtained even at low dopant levels if the sample is thick enough. Figure 2B shows a spectrum obtained with a beam limitted by slits to 50 $\mu m \times 50 \mu m$. Although the spectrum is noisy compared with one obtained with a beam of larger size, it might be possible to obtain good enough spectra with increased integration times. Our glass fiber sample diameter of which is 0.1 mm should also be aligned parallel to the photon beam.

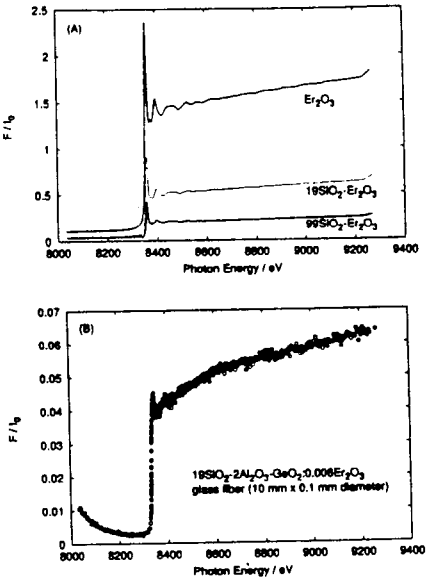

Fig.1. Fluorescence spectra of erbium at the L_{III}-edge.

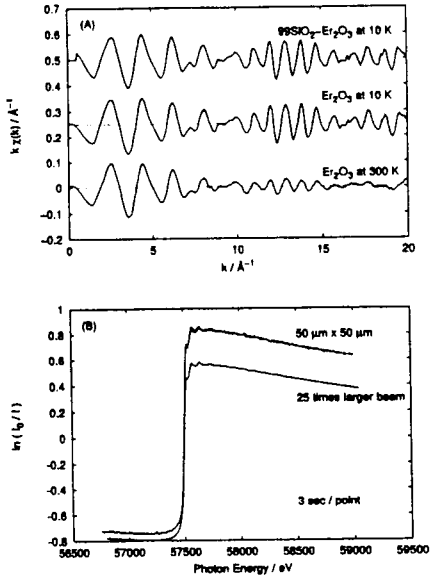

Fig.2. K-edge XAFS spectra of erbium measured using transmission method.