

Report on experiment MA-256 (12-15 May 2007) Erbium local environment in field-assisted ion-exchanged glasses

The presence of silver in rare earth-containing glasses is known to enhance the photoluminescence properties of the rare earth element. Both the intrinsic Er luminescent properties and its enhancement response to the presence of suitable sensitizers come to depend crucially on Er site location inside the glass, in terms of chemical local environment, concentration, and possible local structural rearrangement of the matrix.

In this experiment, Er:SiO₂:Na₂O sol-gel glass films were doped with silver by a field-assisted ion exchange, while in other samples Er was introduced by the same field-assisted procedure. The EXAFS experiment was performed at the Er LIII-edge (GILDA beamline, ESRF) in fluorescence mode, using a 13 elements HP Ge detector; the samples were cooled at LNT. For data analysis the FEFF8-FEFFT code was used.

The main structural information obtained by EXAFS on the Er site are:

- It is formed by 8-10 O atoms, with a Er-O distance of 2.32 Å
- $N > N(\text{Er}_2\text{O}_3)$; according to the bond valence theory also $R > R(\text{Er}_2\text{O}_3)$
- It is not affected by the Ag-Na ion exchange process.

The results allowed to add information in the establishing of a diffusion model that must take into account the local structural modification of the glass matrix upon ion exchange. The collected data, in particular, are used to understand the role of local chemistry in the luminescence response of Erbium in presence of silver atoms and/or aggregates, in order to define an effective preparation protocol which optimizes the material features.

