Preparation of Synthetic Gd and Dy-Doped Silica Glass for Geochemical Reference Material: A Preliminary Characterization

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In order to precisely determine the trace elements such as rare earth elements (REE) in geological and geochemical samples, the selection of reference material is essential for the analysis. Recently, LA-ICP-MS is often applied to the determination of REE in geological and geochemical samples. Laser sampling method enables us to conduct in-situ and rapid local analysis without pre-treatment. However, it is difficult to carry out quantitative analysis by standard curve method because of limited concentration range and heterogeneity of the reference materials. In practical analysis, NIST synthetic glasses are widely used as reference materials for the LA-ICP-MS analysis of the most geological samples. Even NIST reference materials are not sufficient in terms of coverage range of concentration and heterogeneity. In this study, as an initial target REE, Gd and Dy (in the range of 1260 to 25800 ppm Gd or Dy) are selected and synthetic REE-doped silica glasses are synthetically prepared by sol-gel method.

The prepared glass materials are characterized by FT-IR, TG-DTA, XRD, XAFS and LA-ICP-MS to evaluate the bulk and local structure of the glass as well as dispersion of REE in the glass.

XAFS spectrum and radial structure function (RSF) of Gd L3 edge for the samples doping Gd shows no shoulder peak in XANES region and second peak shifted to the low energy side than Gd oxide standard materials. The prepared silica glass has no peak in second coordination in RSF. The distance of the bonding, such as Gd-O, tend to get longer under the well dispersive condition. The first coordination peak (near 2 angstroms) in RSF shifted to the left side. Those suggests that Gd probably exists with relatively well dispersed condition. The result of Dy is almost the same as that of Gd. In the range of 1260 to 25800 ppm Gd or Dy, Gd or Dy doped silica gels could be prepared. Based on the results and discussion of data from various spectroscopic data, Gd and Dy in silica gels are well dispersed and has relatively well heterogeneity.