

An Abstract for an oral presentation, to PNCS-ESG conference 2018

Absorption spectrum analysis of Fe-Ce- and Fe-Cu-doped soda-lime-silica glasses melted with a refiner

Authors: Tarja Volotinen, Uppsala University and Sheffield University; and John Parker, Sheffield University

Abstract

A detailed fitting analysis of the absorption spectra shows significant differences in the structures and concentrations of the Fe^{2+} and Fe^{3+} ions and the Ce- or Cu-ions, dependent on the mutual co-dopant concentrations. The differences are related to the glass composition: 15soda-15 calcia-70 silica with Na_2SO_4 refiner, and on the melting conditions: oxidizing and reducing. The dopant concentrations of Cu, Ce and Fe ions in the studied glasses are low, i.e. below 2 weight %, and the analysis results suggest that there is no 5-coordinated Fe-ions in these glasses.

The fitting parameters obtained for the Fe- and Cu-ion structures are those published in Refs. 1-2 for the 15-15-70-glass. The parameters obtained for the Ce- ions are close to those earlier found in Ref. 3, and the Ce^{3+} charge transfer peak position (wavenumber) varies also with the concentration of the dopant.

The reflectance, over the range from 250 nm and upwards, was seen to follow the refractive index defined as a Cauchy- equation, fitted to the refractive indices measured at several visible and near IR wavelengths. The effect of the reflection loss subtraction method on the absorptance fitting results was found to be one important factor. However, at the low dopant concentrations, the reflectance from the second glass surface at the UV-edge, is dependent on the high absorption inside the glass at the charge transfer peaks of Cu, Ce and Fe ions, but the reflectance seems not to be caused by a large increase of the refractive index. Thus, the charge-transfer occurs between the closest ions (between Fe- and O-ions, and between Cu and O ions and the Ce- and O- ions) in the studied glasses.

References

1. T T Volotinen, J M Parker, P A Bingham, *Concentrations and site partitioning of Fe^{2+} and Fe^{3+} ions in a soda-lime-silica glass obtained by optical absorbance spectroscopy*, Phys. Chem. Glasses: Eur. J. Glass Sci. Technol. B, 49, 5, 258–270 (2008).
2. T T Volotinen, PhD thesis in engineering materials, The University of Sheffield, Faculty of Engineering, Dept. of Engineering Materials, *Mathematical description of absorbance spectra for Fe and Cu doped soda-lime-silica glasses*, 1 – 218 (2007).
3. H Ebdorff-Heidepriem, D Ehrt, *Formation and UV absorption of cerium, europium and terbium ions in different valencies in glasses*, Optical materials, 15, 7-25 (2000).