Control of surface reactivity and non-linear optical properties in borosilicate glasses using thermal poling

A. Lepicard[1,2], M.Dussauze[1], V.Rodriguez[1], K.Richardson[2], T.Cardinal[3]

[1]Institut des Sciences Moléculaires (ISM), Université de Bordeaux, 351 Cours de la Libération, 33405 Talence

[2]Glass Processing and Characterization Laboratory / College of Optics and Photonics, CREOL - University of Central Florida, Orlando, FL 32816

[3]Institut de Chimie de la Matière Condensée de Bordeaux (ICMB), Université de Bordeaux, 87 Avenue du Docteur Albert Schweitzer, 33600 Pessac

Abstract

The control glass substrates surface reactivity at different scales is of a great interest in order to master the properties of future "smart substrates". Within this objective, we aim to design a surface with tailored properties at a submicronic scale using a thermal poling treatment on borosilicate glasses with selected chemical compositions. The chosen glassy systems have a high level of alkali elements which diffuse in the glass during the polarization treatment creating structural changes and the formation of a frozen electric field in the glass. Such an electric field is also responsible for non-linear optical properties, usually forbidden in a centrosymmetric medium. The structural modifications were investigated using Raman, infrared and micro-infrared spectroscopy. Second harmonic generation was evaluated with the Maker fringes technique. Structural changes were linked to the creation of BO_3 units replacing $[BO_4]^-$ entities in the glass after the migration of alkali ions. This leads to a tendency of the glass to attract water at the surface where the poling procedure was performed. Second harmonic generation was also observed which indicates that the centrosymmetry of the glass was broken allowing for the creation of non-linear optical interactions.