08-006

Densification of lithium disilicate glass ceramic under high pressure investigated by XPS

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Structural analysis of glasses under high pressure is important to understand the effect of densification mechanisms on the glass properties. Bridgmann et al. [1] pointed out that the permanent densification after applying high pressure is a phenomenon observed only for glassy materials due to their structural freedom. Kitamura et al [2], based on Raman spectroscopy and radial distribution function, attributed the densification of lithium disilicate Li2O.2SiO2 (LS2) glasses to an increase of the packing density of SiO4 tetrahedra due to a decrease of the Si–O–Si bond angle between the tetrahedra. The aim of this work was to investigate the effect of high pressure on the densification of lithium disilicate glass ceramic with the stoichiometric composition Li2O.2SiO2 (LS2). A group of samples was processed at 2.5 GPa, 4 GPa and 7.7 GPa at room temperature and, for comparison, a pristine sample was also investigated. X-ray photoelectron spectroscopy was used to characterize the chemical environments of Si, O and Li after densification under high pressure. The chemical environments of Si, O and Li were considerably influenced by high pressure. The results showed that a large interaction between Si and O for after processing at 2.5 GPa. For samples processed at 4 and 7.7 GPa the major component of the XPS spectrum of Si environment remained practically unchanged compared to the pristine sample. However, new components with lower intensities also appeared in the XPS spectra indicating the existence of different Si chemical environments in these samples. The chemical environment of the Li was also modified by high pressure. (Work supported by CNPq and CAPES). [1] P. W. Bridgmann, I. Simon, J. Appl. Phys. 24 (1953) 405-413. [2] N. Kitamura, K. Fukumi, H. Mizoguchi,M. Makihara,A.Higuchi,N.Ohno, T. Fukunaga, J. Non-Cryst. Solids 274 (2000) 244-248. [3] S. Buchner, P. Soares, A.S. Pereira, E.B. Ferreira, N.M. Balzaretti, J. Non-Cryst. Solids, 356 (2010) 3004. [4] S. Buchner, C. M. Lepienski, P. Soares Jr, N.M. Balzaretti, Materials Science and Engineering A, 528 (2011) 3921.