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Abstract

Incorporating nitrogen into oxide glasses can lead to a significant modification of their mechanical, thermal, electrical, and optical properties. This is caused by a partial substitution of divalent oxygen ions with trivalent nitrogen ions, enabling the glassy network to become increasingly cross-linked and constrained. Phosphate glasses can easily undergo partial nitridation via thermal ammonolysis, which yields transparent oxynitride glasses with high nitrogen content and significantly improved chemical durability. Most applications of oxynitride glasses involve high temperature applications in air, e.g., as metal sealants or high temperature solid state batteries. It is thus important to understand the thermal behaviour and oxidation resistance of these materials. This work addresses this issue by studying the oxidation behaviour of a sodium oxynitride phosphate glasses with relatively high nitrogen content (N/P=0.5). In detail, we investigate the variations in glass transition temperature (T_g) using differential scanning calorimetry (DSC), while structural transformations are detected by Raman spectroscopy and X-ray diffraction (XRD). Isothermal heat-treatments at temperatures close to T_g are performed in atmospheric air on both bulk and powdered glass samples for different durations. These experiments are compared with dynamic heating experiments up to 500 °C using in situ high-temperature Raman spectroscopy. These results are also compared with elemental probing, as determined by energy-dispersive X-ray (EDX) spectroscopy, of cross-sections of the thermally treated samples.

Brief Biographical Notes

Georgiana-Laura Paraschiv graduated from the Polytechnic University of Bucharest, Romania, with a M.Sc. in 2013, at the Department of Science and Engineering of Oxide Materials and Nanomaterials (SIMONa). In June 2014, she started her work as a Ph.D. student within the Department of Chemistry and Bioscience at Aalborg University, Denmark, under the supervision of Morten M. Smedskjaer and Yuanzheng Yue. Her current research focuses on the structure and properties of oxynitride glasses, particularly the phosphate-based glasses obtained by ammonolysis. She was a Fellow of the Roberto Rocca Education Program awarded by Tenaris Silcotub for the academic year 2012-2013. Laura can be reached at the email: lpa@bio.aau.dk.