

## **Sodium borophosphate glasses modified with niobium pentoxide**

Tomáš Hostinský, Petr Mošner, and Ladislav Koudelka

*Department of General and Inorganic Chemistry, Faculty of Chemical Technology,  
University of Pardubice, 532 10 Pardubice, Czech Republic*

In this contribution borophosphate glasses of the series  $(100-x)[0.4\text{Na}_2\text{O}-0.2\text{Nb}_2\text{O}_5-0.4\text{P}_2\text{O}_5]-x\text{B}_2\text{O}_3$  were studied in a composition range of  $x = 0-48$  mol%  $\text{B}_2\text{O}_3$ . Basic physical properties were determined, and thermal properties studied by differential thermal analysis, thermomechanical analysis, and hot-stage microscopy. The glass structure was investigated using Raman spectroscopy and  $^{11}\text{B}$  and  $^{31}\text{P}$  MAS NMR. The electrical properties of the glasses were obtained by using impedance spectroscopy.

Glass transition temperature increases in range of 0-16 mol%  $\text{B}_2\text{O}_3$ , further additions of  $\text{B}_2\text{O}_3$  results in a decrease of  $T_g$ . All glasses except samples  $x = 8, 16$  crystallize in the temperature range 650-700 ° C. The glass refractive index values follow the trend of  $T_g$ . From  $^{11}\text{B}$  MAS NMR spectra development is visible that the relative number of  $\text{BO}_4$  boron species with tetragonal coordination decreases with increasing  $\text{B}_2\text{O}_3$  content, while the number of trigonal  $\text{BO}_3$  species increases.  $^{31}\text{P}$  MAS NMR spectra of studied glasses contain one major resonance which shifts upfield with increasing content of  $\text{B}_2\text{O}_3$ . This shift is due to the increasing connectedness of the glass network, which is based on the decrease in the number of  $\text{Na}^+$  cations. Raman spectra are mainly dominated by the vibration of the Nb-O bond in the  $\text{NbO}_6$  octahedra. The intensity of this vibration decreases with decreasing  $\text{Nb}_2\text{O}_5$  content. With the addition of  $\text{B}_2\text{O}_3$ , a decrease in DC conductivity is observed, which is attributed to the decrease in the concentration of  $\text{Na}^+$  ions.