Structure and properties of barium tungstate-phosphate glasses

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Abstract

Tungsten oxide is able to form broad glass forming regions with phosphate glasses. Materials based on WO3 are known for their electrochromic and photochromic properties, which result in a wide range of applications, such as smart windows, display devices, or sensors. Barium phosphate glasses of the composition (100-x)Ba(PO3)2-xWO3 with 0-60 mol% WO3 were prepared and studied. All glasses reveal very high chemical durability. Thermal studies of the glasses were carried out with DTA, dilatometry and hot-stage microscopy. Glass transition temperature in this glass series increases with increasing WO3 content from 447∘C (x = 0) to 635∘C (x = 60). All glasses containing WO3 crystallize on heating within the range of 650-750∘C with the exception of the glass with 20 mol% WO3, which is thermally stable. The effect of composition on the properties of these glasses and the relations between composition, structure and properties were evaluated. 31P MAS NMR studies were devoted namely to the investigation of changes in phosphorous coordination in the dependence on WO3 content. The gradual shortening of phosphate chains in the direction Q2®Q1®Q0 was observed in the studied compositional series. Compositional dependence of the amount of Qn units was obtained by the decomposition of the spectra. Changes in the network structure of phosphate glasses can be deduced also from changes in their Raman spectra which confirmed the shortening of phosphate chains by the incorporation of tungstate structural units, most probably in the form of WO6 octahedra. These octahedra form clusters via W-O-W bonds, the number of which increases with increasing WO3 content.

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