

## Structural characteristic of $\text{Na}_2\text{O} \cdot \text{P}_2\text{O}_5 \cdot \text{GeO}_2$ glass systems

### Abstract

Phosphate glasses based on  $x\text{Na}_2\text{O} \cdot 0.5\text{P}_2\text{O}_5 \cdot (0.5-x)\text{GeO}_2$  ( $0.0 \leq x \leq 0.5$ ) mol%, were prepared and their structures were characterized by magic angle spinning (MAS) nuclear magnetic resonance (NMR), Raman and IR spectroscopy techniques. It was found that the phosphate network of these glasses is composed of middle ( $Q^2$ ) and branching ( $Q^3$ ) phosphate tetrahedra, whereas germanium part in the network is composed of three- or four-membered  $\text{GeO}_4$  tetrahedral rings. It was also found that the germanium tetrahedral are randomly connected to either  $Q^2$  or  $Q^3$  phosphate units in the network. The glass network, especially the  $Q^2$  units can be modified by the presence of Na ions. This modification is primarily associated with the phosphate. It is found that these glasses behave as if they are formed from a solution of  $\text{GeO}_2$  and sodium-phosphate glass with various  $\text{GeO}_4$  units and the  $Q^2$  and  $Q^3$  phosphate units randomly distributed in the network.