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The Long-Wavelenght Limit of the Structure Factor of Mixed Metaphosphate Glasses

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Frozen-in fluctuations in concentration and/or topological density are inherent in any glass and determine the value of the long-wavelenght limit, $S(0)$, of the structure factor. Among the phosphate glasses, most interest has been directed to those with metaphosphate composition. The structure of metaphosphate glasses can be described in terms of anionic phosphate chains and/or rings possessing no cross-links; charge compensation requires a well-balanced distribution of the metallic cations around them. Thus, we interpret the binary metaphosphate glasses as pseudo one-component glasses, i.e. it is assumed that in these glasses only fluctuations in number density exist. The present paper is aimed at extending this approach to ternary metaphosphate glasses which, consequently, are treated as pseudo two-component systems. Effects of substitution of K_2O for Na_2O, BaO for SrO and BaO for Na_2O in mixed metaphosphate glasses have been studied by X-ray diffraction. The compositional dependence of $S(0)$ is discussed in terms of ideal and non-ideal mixture models using the Bhatia-Thornton formalism. Whereas for the K-Na system a random mixture of the two types of metaphosphate units is consistent with the experimental data, a preferred formation of dissimilar pairs is indicated for the Ba-Sr system. On the other hand, a strong tendency toward segregation of $NaPO_3$ and $Ba(PO_3)_2$ units has been found in the mixed alkali-alkaline earth glasses.

Keywords: X-ray diffraction, intermediate-range order of glasses, phase separation