
Composition formulas of silicate glasses

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Abstract

The cluster-plus-glue-atom model is introduced to model silicate glasses in the form of a molecule-like supercluster unit $\{M_2O_3\}_n\{Si_2O_4\}_{16-n}$ as the composition carrier, where M represents an average trivalent cation, in correspondence to the coordination numbers of 3 to 4 according to the random network model. Soda-lime-silicate, aluminosilicate, and borosilicate glasses of historical importance are addressed. Classical soda-lime-silica glasses as exemplified by 1:1:6 standard glass and modern aluminosilicate glasses such as Corning Gorilla glasses of the first generation generally satisfy trivalent-cation formulas $\{M_2O_3\}_{16}$. Borosilicate glasses are characterized by extra quadrivalent $\{Si_2O_4\}$, as exemplified by Corning E-glass and Schott thermometer glass formulated by $\{M_2O_3\}_{12}\{Si_2O_4\}_4$, Schott utensil glass by $\{M_2O_3\}_{16}\{Si_2O_4\}_6$, and Corning Pyrex and Schott Welsbach chimney glasses by $\{M_2O_3\}_7\{Si_2O_4\}_9$.

Keywords: silicate glasses, cluster, plus, glue, atom model, composition formula, structure unit

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