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A Multispectroscopic Structural Study of Lead Silicate Glasses over an Extended Range of Compositions¹

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A series of lead silicate glasses, spanning the broadest reported range of lead contents (up to 83 molar percent PbO), were prepared, on which the following spectroscopic observations were made: ²⁹Si magic angle spinning NMR, MS-TOF, Raman and FTIR. For bulk, splat-quenched samples, infra-red results indicate that the lever rule ($Q^n \rightarrow Q^{n-1}$) is approximately followed until about 60 molar percent PbO, though with considerable dissociation of the stoichiometric groups into silicate units with lesser and greater numbers of non-bridging oxygens as shown in the equilibrium relation $2Q^n \rightarrow Q^{n+1} + Q^{n-1}$. For roller-quenched samples, NMR data are consistent with a statistical distribution up to this lead concentration. Above 60 molar percent PbO, added oxygen remains associated with lead to form a separate lead oxide glass network. The evidence for this comes from each of the spectroscopic techniques employed. A quantitative distribution of PbO is given.

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