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STRUCTURE, DYNAMICS AND RELAXATION OF DENSIFIED INORGANIC GLASSES

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As noted by Nemilov [1], the fact that glasses are examined mostly at a pressure of 0.1 MPa is in some sense only an accident, and the glass would behave differently if the ambient pressure were different. Contrary, it is known as a rule that nucleation and crystallization strongly depend on pressure, and that, as in almost all natural systems, even completely different species might evolve in dependence on the surrounding pressure. Pressure-induced polyamorphism, too, has been demonstrated for several glasses in recent years [2] - a fact that further underlines the importance of pressure-related phenomena in glass science, and the ongoing transfer of geologic approaches to technical glasses.

Here, we are focussing on the glass transition in the regime of comparably low pressures, i.e. ambient to 1 GPa, where polyamorphism is unlikely to occur. It has been shown only recently that within this regime, distinct effects can be observed in the calorimetric features of several inorganic glasses – silicates and phosphates – when relaxing towards ambient pressure, and that indeed melt compression has a similar effect as cooling much slower at lower pressure [3]. Those observations and their general implications to the glass transition in the presence of pressure-relaxation, however, are still far from understood.

Employing the concept of energy landscapes, two quasi-independent contributions define the properties of melts that are trapped on different states of configurational excitation: vibrational dynamics and structure [4, 5] – or potential and kinetic energies. In freezing melts at elevated pressure and studying their properties as well as relaxation towards ambient pressure, we consider and compare both thermal (cooling rate) and mechanical (compression) histories with respect to the two aspects. Recent results of a series of experiments, employing standard NCS, NBS and binary NS glasses, as well as molecular dynamic simulations will be presented, and conclusions for macroscopic properties will be drawn.

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