Structure of SiO_2 Melts at Megabar Pressures

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SiO_2 is one of the most fundamental constituents in planetary science, being vastly abundant in the Earth's crust and mantle. As an essential 'building block', it bonds with Mg, Fe and other elements to form major mineral phases and even free SiO_2 can be expected in localized regions in the Earth's mantle, derived from e.g. subducted oceanic crust [1]. The stability of SiO_2 within these regions is affected by polymorphism at high pressures and SiO_2 serves as an archetype for the dense highly coordinated silicates of planetary interiors and large (1-10M⊕) exoplanets [2]. Seismological heterogeneities in the ultralow velocity zones (ULVZs) at the upper end of the transition zone and at the core mantle boundary (CMB) have been interpreted with the presence of higher coordinated SiO_2 melts [3,4]. The possible presence of silicate melts may result from partial melting of the lowermost mantle minerals or are remnants of the dense basal magma ocean [5], however, up to date it is only little known about these SiO_2 melts within the field of geosciences.

We carried out time-resolved X-ray diffraction studies of silicon dioxide (SiO_2) at megabar pressures, using the long-pulse laser and shock diagnostics at the MEC end-station of the Linac Coherent Light Source (LCLS), USA. Our study mainly focused on the *in-situ* investigation and determination of Si-O coordination and bond length in silicate melts, and consequently, its structure factors and radial distribution. Due to its recent upgrade, the ns-laser at MEC allowed us to compress SiO_2 (fused silica and quartz) to pressures of up to 140 GPa following its Hugoniot and reaching temperatures corresponding to the SiO_2-liquidus regime. While simultaneously probing the samples with highly resolved X-ray diffraction at various time delays, it was possible obtain time-resolved information of the lattice structure during phase transitions, melting and re-crystallization of SiO_2.

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