Shock-compressed behavior of quartz by XFEL

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We have conducted x-ray diffraction measurement (XRD) with femtosecond x-ray pulses generated by the x-ray free electron laser (XFEL) to observe lattice dynamics and phase transformation of single-crystal quartz under high strain-rate shock compression (~10^9 s^{-1}) and high pressure. Single-crystal quartz samples were shock-compressed by high-power short- and long-pulse lasers. In the short-pulse experiments, the lattice was reduced to 15% and 1.5% in the direction parallel and perpendicular to the compression axis, respectively. The sample was uniaxially compressed over its known Hugoniot elastic limit. In the long-pulse experiments, three different states were observed. Polycrystalline stishovite appeared at first, and elastically compressed state and a topotaxially transformed new phase were observed successively.

Keywords: Shock compression, in-situ X-ray diffraction, quartz

