Femtosecond diffraction studies of phase transitions in Sodium Chloride under dynamic shock compression

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Sodium Chloride (NaCl) is of strong interest in high-pressure science, geoscience, and dynamic compression experiments (Nishiyama et al., 2003; Fritz et al., 1971, Dorogokupets et al., 2007). At room temperature, NaCl undergoes a phase transition from the B1 ($Fm\bar{3}m$) rocksalt structure to the B2 ($Pm\bar{3}m$) CsCl structure at around 25 GPa. This B1→B2 phase transition is exhibited by Oxides such as CaO and MgO at much higher pressures. In spite of the several experimental studies on NaCl, the B1→B2 and B2→liquid phase transition data under rapid compression is still limited. Here, we report the in-situ X-ray diffraction and velocimetry of NaCl single crystal (30 μm-thick) under laser driven shock compression. Experiments were conducted at the Matter of Extreme Conditions end station of the LCLS X-ray laser at the SLAC National Laboratory. A laser shock is generated by focusing a 527 nm, quasi flat-top 20 ns pulse within a 250 and 500 μm diameter on front surface of the target package, which consists of a polyimide ablator, NaCl sample, and LiF window. The sample is probed by 50-femtosecond X-ray pulse. A signature of melting around

62 GPa in NaCl crystal has been observed, giving insight to the behavior of solid and liquid phases under shock compression on nanosecond timescales.

References

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