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Freezing of liquid water under combined compression and electric fields[1] S.J.P. STAFFORD, S.N. BLAND, Imperial College, D.H. DOLAN, Sandia National Labs, D. EAKINS, Imperial College, INSTITUTE OF SHOCK PHYSICS COLLABORATION[2], SANDIA NATIONAL LABS COLLABORATION[3] — The melt curves of materials hold rich information concerning phase stability, co-existence, and other kinetics, typically studied through heating and cooling. Compression-induced solidification exposes new kinetics, yet is a practical challenge due to adiabatic heating. Water has a large heat capacity and many solid phases, making it a good candidate for compression freezing. Optical transmission measurements and high-speed imaging have demonstrated that water can freeze on nanosecond time scales. Being highly polar, freezing in water is strongly influenced by electric fields at atmospheric pressure. However, the role of external electric fields in freezing has yet to be determined at high pressure. We present experimental and theoretical results from our attempts to transform liquid water into solid ice under rapid compression. To minimize heating, samples are quasi-isentropically compressed via multiple shock or ramp wave compression. An external electric field applied to the sample imparts local order to the system, influencing solidification onset and growth. Classical molecular dynamic simulations show significant ordering effects at V/nm field strength, well above the dielectric strength of water. We present work that to address this issue.

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Sam Stafford
Imperial College

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