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Dynamic compression of diamond across the melt transition[1]

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The past two years have seen dramatic improvements in dynamic compression experiments on diamond using laser-induced compression methods. We will present an overview of our current experimental understanding of the phase-diagram and equation of state of high pressure carbon. We have carried out: (i) measurements the shock Hugoniot up to 3600 GPa; and, (ii) measurements of the shock front temperature along the Hugoniot that show a clear slope discontinuity when the Hugoniot enters the solid-liquid coexistence region providing the first direct observation of the pressure-temperature locus along the melt curve between 850-1100 GPa. Comparison with recent quantum molecular dynamics calculations shows better agreement than with previous models. In addition, we have observed a rate-dependent elastic limit ranging between 60 and 200 GPa. From these experiments we have been able to extract a wide variety of thermodynamic quantities, including the latent heat of fusion, the volume discontinuity at melt and the specific heat at very high pressures. In collaboration with J.H. Eggert, D.K. Bradley, A.A. Correa, E.F. Schwegler, D.G. Hicks, R.F. Smith, R.S. McWilliams, and G.W. Collins of LLNL; T.R. Boehly and J.E. Miller of the University of Rochester.

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