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Quasi-isentropic Compression Waves Generated by Shock Waves into Sapphire[1] W. J. NELLIS, Harvard University, G. I. KANEL, S. V. RAZORENOV, A. S. SAVINYKH, Institute for High Temperatures, A. M. RAJENDRAN, U. Mississippi — For sixty years it has tacitly been assumed that a shock wave incident on a material will propagate as a shock wave in that material. Between 15 and 80 GPa a shock wave cannot propagate in sapphire, the first material demonstrated not to have a Hugoniot. Wave profiles of sapphire crystals with three orientations and two thicknesses were measured at incident shock stresses of 14, 24 and 87 GPa. 14 GPa generates elastic shocks that are overdriven at ∼90 GPa. Elastic-precursor decay occurs at 24 and 87 GPa. At 24 GPa all three orientations have plastic-compression waves with rise times of 200-300 ns. Long rise times are probably caused by strong bonds that break heterogeneously and statistically over a relatively long time interval. This slow damage-induced increase in pressure causes quasi-isentropic compression. Since the Hugoniot and isotherm of sapphire are essentially coincident up to 340 GPa, dissipative energy probably goes primarily into entropy of disordering the crystal rather than temperature.

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