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Thermoelasticity of ε-FeSi to 8 GPa and 1273 K

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Abstract

The elastic properties of ε-FeSi were investigated at high temperature and pressure using a combination of ultrasonic interferometry and synchrotron radiation up to 8 GPa and 1273 K. The unit-cell volumes and sound velocity data were fit to third-order finite-strain equations with adiabatic temperature conversions to maintain a thermodynamically internally consistent data set. The adiabatic zero-pressure bulk and shear moduli and their first pressure and temperature derivatives were obtained from this fitting: K_{S0} = 168.9(7) GPa, G_0 = 116.5(3) GPa, K_{S0}' = 6.6(2), G_0' = 2.9(1), $(\partial K_{S0}/\partial T)_P$ = –0.023(1) GPa/K, $(\partial G_0/\partial T)_P$ = –0.030(1) GPa/K. This study presents the first complete thermodynamically consistent set of elastic moduli and their temperature and pressure derivatives.

Keywords: Ultrasonic interferometry, equation of state, iron silicide, elastic properties, high pressure, high temperature