American Mineralogist, Volume 106, pages 1744–1750, 2021

Sound velocities of iron-nickel ($Fe_{90}Ni_{10}$) alloy up to 8 GPa and 773 K: The effect of nickel on the elastic properties of bcc-iron at high *P-T*

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Abstract

Sound velocities of iron and iron-based alloys at high pressure and high temperature are crucial for understanding the composition and structure of Earth's and other telluric planetary cores. In this study, we performed ultrasonic interferometric measurements of both compressional (v_P) and shear (v_S) velocities on a polycrystalline body-centered-cubic (bcc)-$Fe_{90}Ni_{10}$ up to 8 GPa and 773 K. The elastic moduli and their pressure and temperature derivatives are derived from least-square fits to third-order finite strain equations, yielding K_{S0} = 154.2(8) GPa, G_0 = 73.2(2) GPa, K'_{S0} = 4.6(2), G'_0 = 1.5(1), $\partial K_S/\partial T$ = –0.028(1) GPa/K, and $\partial G/\partial T$ = –0.023(1) GPa/K. A comparison with literature data on bcc-Fe suggests that nickel not only decreases both P and S wave velocities but also weakens the temperature effects on the elastic moduli of Fe-Ni alloys.

Keywords: Fe-Ni alloy, sound velocity, high pressure and high temperature, ultrasonic interferometry