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Calorimetry at high-pressure using high-frequency Joule-heating
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Calorimetric measurements of materials at 1 to 100 GPa of pressure would provide intriguing tests of condensed matter theories, sensitive probes of chemical reactions during high-pressure synthesis, and useful inputs for models of the Earth's interior. We present the design and first results of quantitative heat capacity measurements at >10 GPa of pressure. High-frequency AC voltage heats a small metal strip pressed between diamond anvils, creating temperature oscillations whose amplitudes are determined from the higher harmonics of voltage. Thermal models show that frequencies >100 kHz are required to contain heat in the ng-mass samples, while electrical models show that frequencies >100 MHz are not practical. Our experimental results show that the heat capacity of iron and nickel can indeed be measured at high frequencies in diamond anvil cells, paving the way for studies of the energetics of a wide-variety of entropy-driven phase changes at high pressure.

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