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Equation-of-state and transport properties of liquid and solid CO_2 shock-compressed to 1 TPa and 93,000 K[1]

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Equation-of-state and transport measurements of shock-compressed CO_2 at and above the insulating-to-conducting transition reveal new insight into the chemistry of simple molecular systems in the warm-dense-matter regime. In this work, we extend the measured CO_2 liquid and solid Hugoniots to 1 TPa, and present the first temperature measurements of shocked CO_2 to 93,000 K. CO_2 was precompressed in diamond-anvil cells before being dynamically compressed with laser-driven shock waves. Uniquely, the different initial densities in these experiments allow us to extract thermodynamic derivatives, including specific heat and Gruneisen coefficient. At the most extreme conditions we reach, the data is inconsistent with a simple atomic fluid. A constant reflectivity implies a constant carrier density, but a rising specific heat implies increasing degrees of freedom. We conclude that at these conditions, CO_2 is more likely an electrically conducting bonded fluid of increasing chemical complexity.
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