Melting, metallization, and the high-pressure, high-temperature phase diagram of sulfur

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Despite being the fifth most abundant element on Earth and the tenth most abundant element in the universe, the properties of elemental sulfur at the pressure and temperature conditions of deep planetary interiors remains largely unknown. Sulfur undergoes solid phase transitions, liquid-liquid phase transitions, drastic optical changes, metallization, and further transformations under pressure, making it a playground for materials characterization. Using laser-heated diamond anvil cell experiments combined with ex-situ textural analysis, we measured the melting curve of sulfur to 65 GPa, over a five-fold increase from previous studies. We used in-situ synchrotron x-ray diffraction to determine the location of solid phase boundaries at high temperatures and to confirm melting. We also performed infrared absorption and reflection measurements to follow the insulator-to-metal transition in sulfur and relate its optical properties to its phase diagram. Together, this new experimental data paints a more detailed picture of the behavior of sulfur at extreme conditions.

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