Transparency of shock-compressed single crystal diamond

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Carbon is one of the most prominent elements in nature and it is abundant in the Earth and many other planets. Diamond, a metastable phase of carbon, is naturally synthesized in deep inside of the Earth where substances are isotropically pressured. Diamond is known for its many unique properties such as high hardness, low compressibility, small thermal expansion coefficient, and transparency. Since it is important to understand how substances behave under high pressure, properties of compressed diamond have been measured in a wide range of pressures up to 5 TPa. However, the transparency of diamond under pressure has not been fully elucidated. Here, we report the measurment of the pressure dependency of the absorption coefficient of laser shock compressed single crystalline diamond. A high-intensity laser was utilized to shock compress the diamond sample along its <100> direction, and velocity interferometer systems for any reflector (VISARs) were used to determine the absorption coefficient and pressure. It was found that single crystalline diamond remains largely transparent to the probe laser for VISAR (λ=532 nm) up to 140 GPa. The pressure dependence of the refractive index will also be discussed.

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