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EQUATION OF STATE DATA OF SHOCK COMPRESSED LIQUID CO_2 and SYNTHETIC URANUS

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New Hugoniot equation-of-state data for liquid CO_2 and synthetic Uranus are discussed. These CO_2 data and the previous data of Schott indicate that CO_2 begins to dissociate at about 33 GPa on the Hugoniot. Four double-shock points were obtained for synthetic Uranus up to 220 GPa and 3 g/cm^3. These data are coincident with the adiabat of Uranus calculated by Hubbard and Marley.

1. RESULTS

CO_2 is considered to be a major reaction product of detonated explosives. Hugoniot equation-of-state data for CO_2 are needed to derive an intermolecular potential to construct theoretical equations of state of reacted explosives and to determine the range of stability of the CO_2 molecule at high pressures and temperatures. For these reasons 4 Hugoniot data points for liquid CO_2 initially at 1.17 g/cm^3 and 219 K were obtained in the pressure range 28-71 GPa. The lowest pressure point is in good agreement with the u_s-u_p fit to the previous data of Schott[1] in the range 12-30 GPa. The three points at higher pressures show a change of slope in the u_s-u_p curve at about 33 GPa. This behavior is similar to that obtained previously for CO and N_2 and is interpreted in terms of molecular dissociation.

Synthetic Uranus is a liquid which is representative of the chemical composition expected in the interior of the planet Uranus, and Neptune as well. It is a mixture of water, ammonia, and isopropanol. Equation-of-state data were measured previously using single-shock compression up to 76 GPa.[2] Double-shock compression to a given density produces temperatures and pressures which are substantially lower than achieved by single-shock to the same density. This process permits one to achieve a range of states close to planetary adiabats. For this reason synthetic Uranus was double-shocked to pressures in the range 98-218 GPa. Our 4 new data points for synthetic Uranus are in excellent coincidence with the pressure-density relation in Uranus calculated by Hubbard and Marley.[3] The 3 g/cm^3 we achieved corresponds to a depth of about one-half the radius of Uranus, or about 12,000 km.

2. ACKNOWLEDGEMENTS

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