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Investigating Metallization in Shock-Compressed Alkali Halides

MATTHEW DIAMOND, Univ of California - Berkeley — Laser-shock compression on four alkali halides has been used to probe the transition from insulating to metallic states, a high-pressure transition in chemical bonding that has fundamental implications for planetary formation and structure. Collectively, pressures up to 450 GPa were explored across a total of fourteen single-crystal samples of CsI, CsBr, KBr and NaCl. Velocity interferometry was used to record shock velocities and reflectivities at 532 nm during decaying shock compression. The data show up to three-fold increases in density as well as significant increases in optical reflectivity in response to high pressures and temperatures. Ionic salts are simple model systems amenable to first-principles theory and serve as analog materials for predicting whether specific chemical constituents can reside in the rocky mantles or metallic cores of planets. A key objective is to disentangle the complementary roles of temperature and compression in transforming ionic into metallic bonding. Furthermore, at high pressures CsI becomes analogous to Xe: they are isoelectronic and follow matching equations of state. Therefore, studies on CsI can inform understanding of noble-gas geochemistry at conditions deep inside planets.

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