Shock-wave study of the metallization of alkali halides up to 500 GPa

Orianna B Ball[1]*, Suzanne Ali[2], Jon Eggert[2], Gilbert W. Collins[3], Matt Diamond[4], Raymond Jeanloz[4] and R. Stewart McWilliams[1]

[1]*School of Physics and Astronomy and Centre for Science at Extreme Conditions, University of Edinburgh, Edinburgh EH9 3FD, UK*

[2]*Lawrence Livermore National Laboratory (LLNL), Livermore, CA 94550, USA*

[3]*Department of Mechanical Engineering, Physics and Astronomy and Laboratory for Laser Energetics, University of Rochester, Rochester, NY 14623, USA*

[4]*Department of Earth and Planetary Science and Department of Astronomy, University of California, Berkeley, CA 94720, USA*

Keywords: high pressure, alkali halides, shock compression.

*e-mail: O.B.Ball@sms.ed.ac.uk

Alkali halides are of fundamental interest to the shock wave community, for the number of fundamental phase transformations they exhibit under shock compression and their utility as optical window materials. However, the phase transition from wide band gap insulator into electrical conductor, observed in many insulators under shock and static compression (e.g in diamond [1] and quartz [2]) has been poorly explored for the alkali halides. Meanwhile legacy results of Russian experiments pose a number of unresolved questions such as the possibility of nonequilibrium behavior at Mbar shock pressures.

In this study we investigate the optical properties of alkali halides NaCl, KBr, CsBr, and CsI under shock loading up to 5 Mbar, by measuring shock wave speed and reflectivity using line VISAR in laser-driven, decaying-shock experiments. Significant increases in the optical reflectivity in all four alkali halides indicate conditions of metallization at high pressures. The results are analyzed with respect to previous optical measurements, obtained in dynamic and shock compression, for the alkali halides. Together with prior work on LiF, we explore the trends of electronic transformations under dynamic compression over a range of alkali halide composition.

Acknowledgments: This work was supported by EPSRC grant Ep/P024513/1.

[1] Bradley, D.K., et al., *Shock compressing diamond to a conducting fluid*. Physical Review Letters, 2004. 93(19): p. 195506.

[2] Hicks, D.G., et al., *Dissociation of liquid silica at high pressures and temperatures*. Physical Review Letters, 2006. 97(2): p. 025502.