Abstract Submitted
for the SHOCK11 Meeting of
The American Physical Society

Strength and formation of poor metals from insulators: bonds to bands in Al2O3 and H2 W.J. NELLIS, Harvard University — HELs of Al2O3 and H2 are ∼15 GPa and 0, respectively, while Al-O and H-H bond energies are both 4.5 eV and both are wide gap insulators at ambient. Al2O3 is a likely metallic glass at ∼300 GPa; hydrogen is a metallic fluid at 140 GPa. How can such different materials at ambient both be disordered poor metals at 100 GPas? As McQueen pointed out, shock dissipation TS is absorbed in temperature T and entropy S (disorder). Because of strength, the split between T and S differs greatly between these two. H2s interact via weak pair interactions, which means high compressibility, high shock Ts, and dissociation (S) to monatomic metal at high pressures. Al and O atoms interact strongly via directional bonds in large 3D networks. Dissipation is first absorbed breaking bonds (S), which keeps T and thermal pressure low up to 400 GPa. Once most Al-O bonds are broken, Al2O3 is amorphous and atom densities so large that atomic wave functions probably overlap to form a metallic glass. Existing conductivity measurements to 220 GPa need to be extended to ∼300 GPa to test this prediction.

W.J. Nellis
Harvard University

Date submitted: 08 Feb 2011 Electronic form version 1.4