Abstract Submitted
for the SHOCK13 Meeting of
The American Physical Society

Shock compression of single crystal and polycrystalline tantalum from 6 – 23 GPa GLENN WHITEMAN, SIMON CASE, JEREMY MILLETT, AWE — A series of plate impact experiments have been performed to produce simultaneous shock loading of both polycrystalline and the three principal orientations of single crystal tantalum ([100], [110] and [111]) to peak stresses between 6 and 23 GPa. Measured free surface wave profiles demonstrate that the shock behaviour varies significantly between the four variants, exhibiting differences in upper and lower elastic limits, shock velocities and peak stress. Initial findings reveal that the [100] orientation exhibits the largest elastic limit. Shock velocity measurements indicate that for all of the materials, and most notably in the [100] orientation, there is a low stress excursion from a linear Us-up plot similar to that previously seen in polycrystalline tantalum. This suggests sensitivities at low stress which require further investigation. The experiments have been simulated using a single crystal plasticity finite element model that accounts for thermally-activated and drag-resisted dislocation motion, and for evolution of the dislocation density. The model is seen to qualitatively describe some of the features described above.

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Date submitted: 05 Dec 2012 Electronic form version 1.4