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Title: Zr Extrusion – Direct Input for Models & Validation

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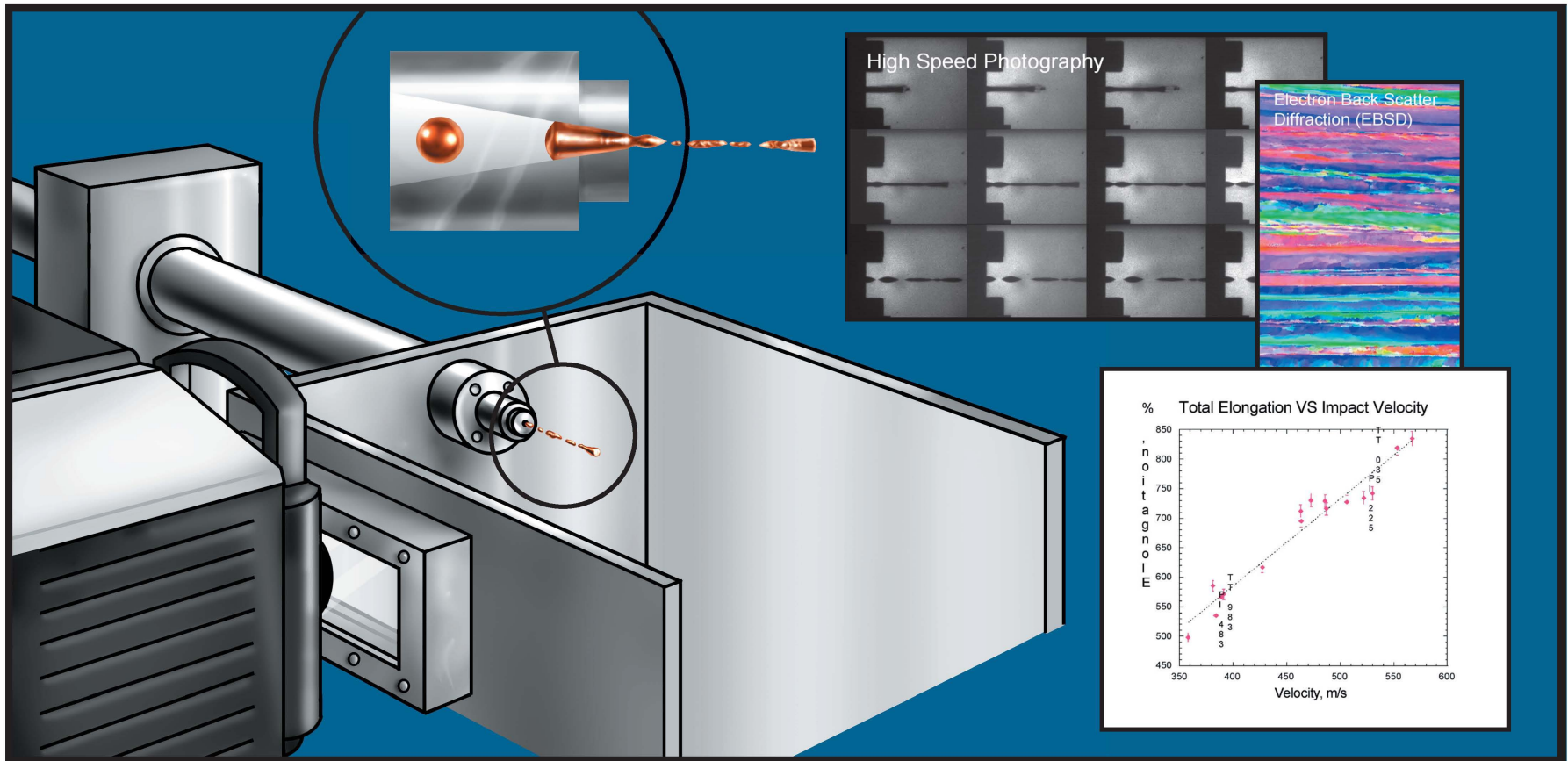
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Zr Extrusion – Direct Input for Models & Validation

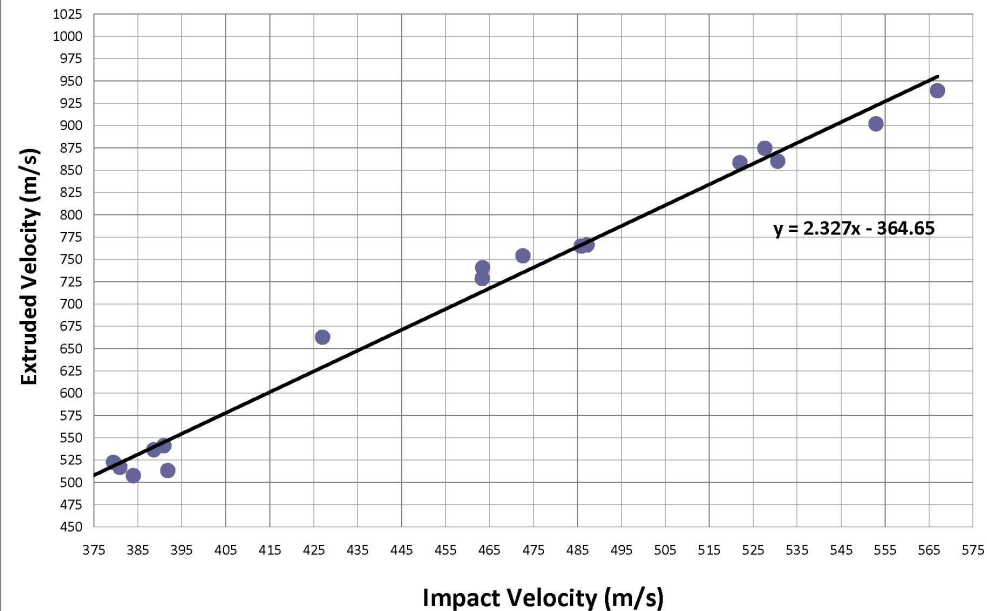
As we examine differences in the high strain rate, high strain tensile response of high purity, highly textured Zr as a function of loading direction, temperature and extrusion velocity with primarily post mortem characterization techniques, we have also developed a technique for characterizing the in-situ extrusion process. This particular measurement is useful for partitioning energy of the system during the extrusion process: friction, kinetic energy, and temperature

Schematic Illustration Showing Dynamic Extrusion and Diagnostics

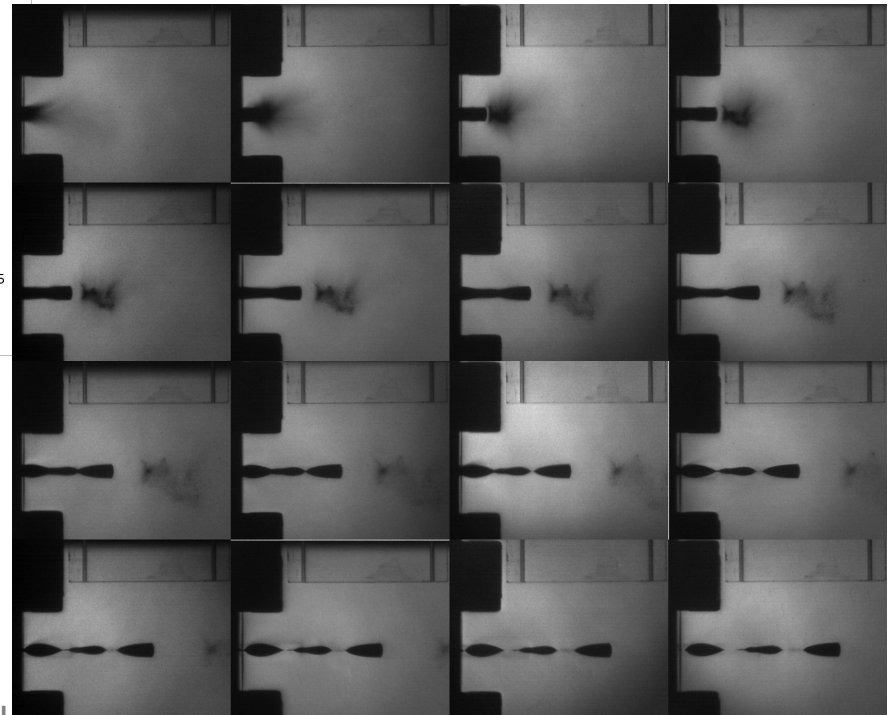


Typical Data Generated: Total Elongation, Exit Velocity

Tantalum Impact Velocity VS. Extruded Velocity

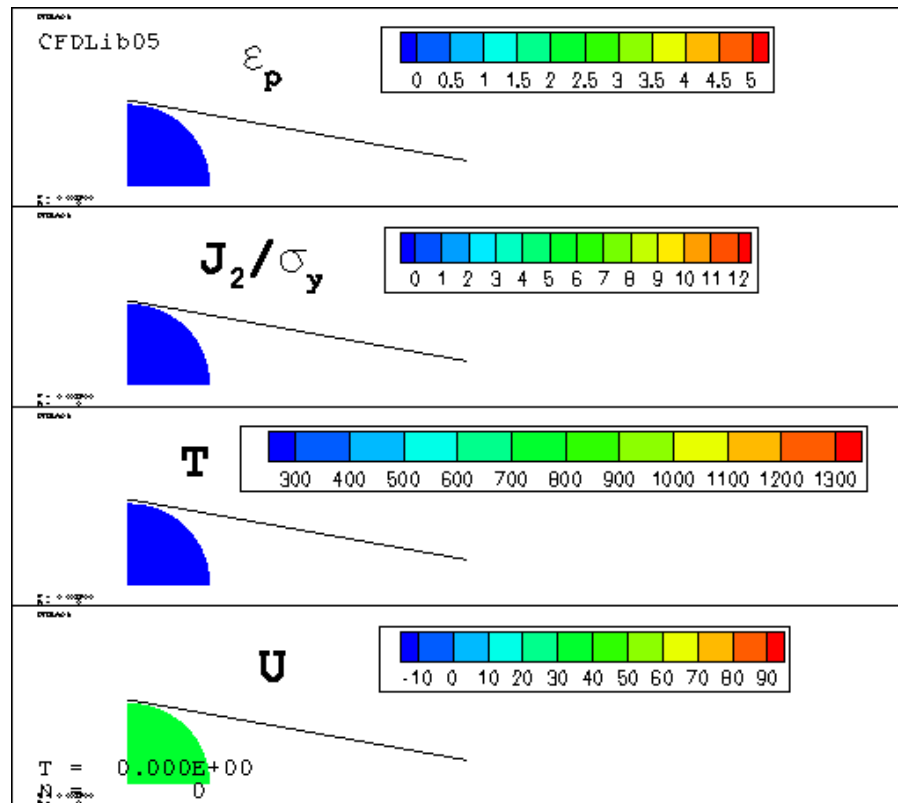


High Speed Imaging

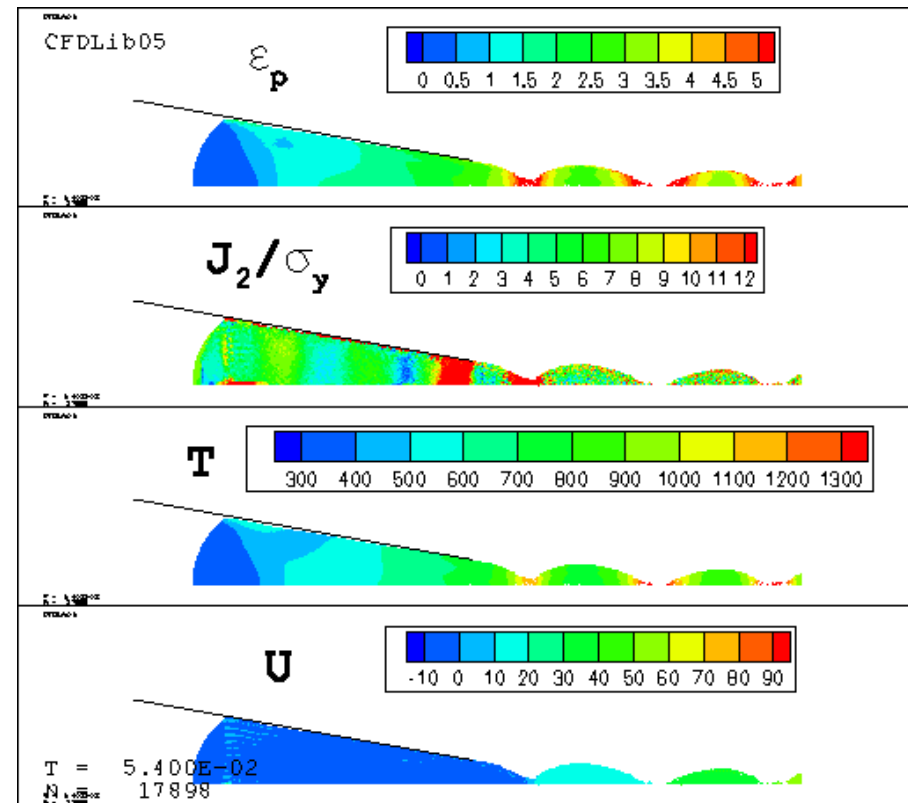


Elongation as a Function of Velocity

Uncertainties of the Simulation Influence Predictive Capability

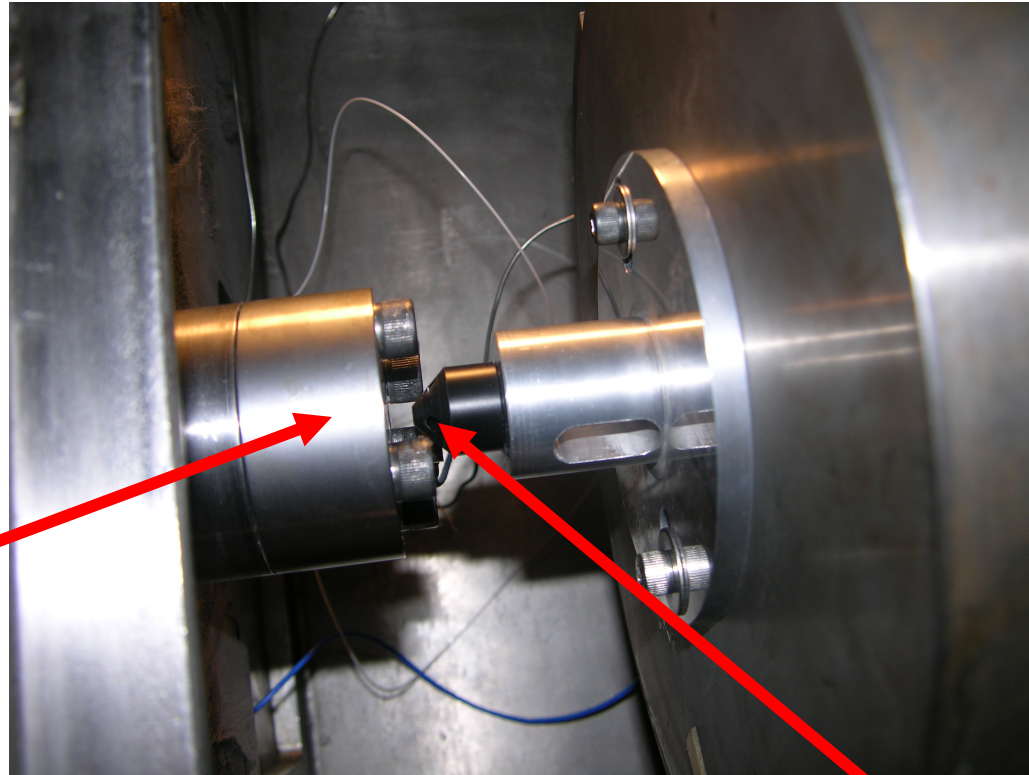


T = 0



T = 0.054ms

New Use of a PDV Diagnostic to Acquire Transit Times and Velocity Through the Die



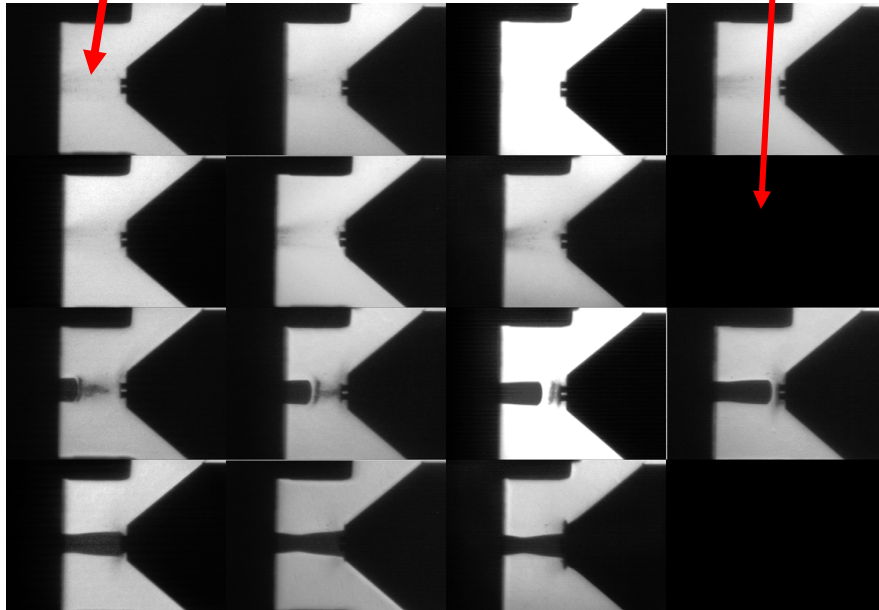
Die holder

PDV Probe
holder $\frac{1}{2}$ " from
exit of die

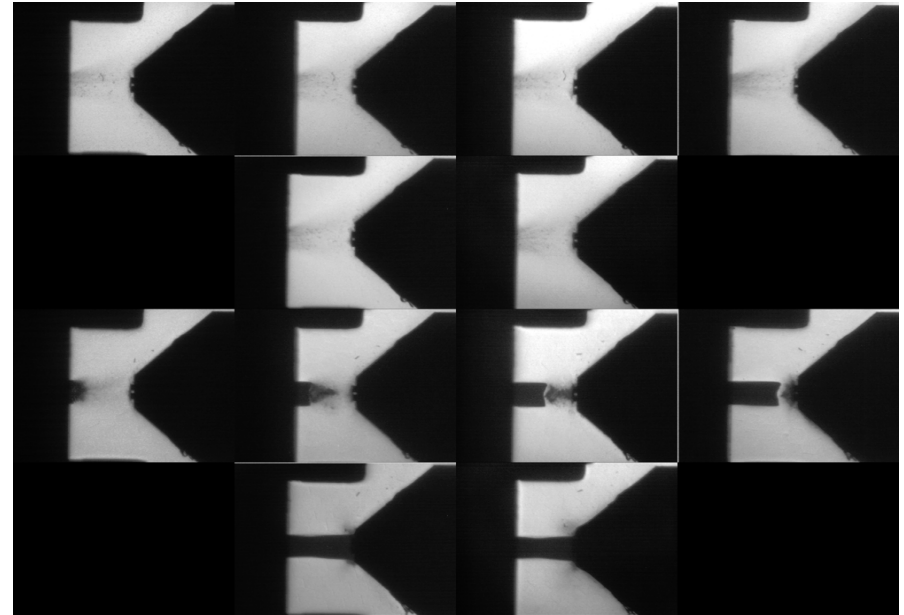
PDV is Correlated to High Speed Photography

1us after trigger
source

15us after trigger source

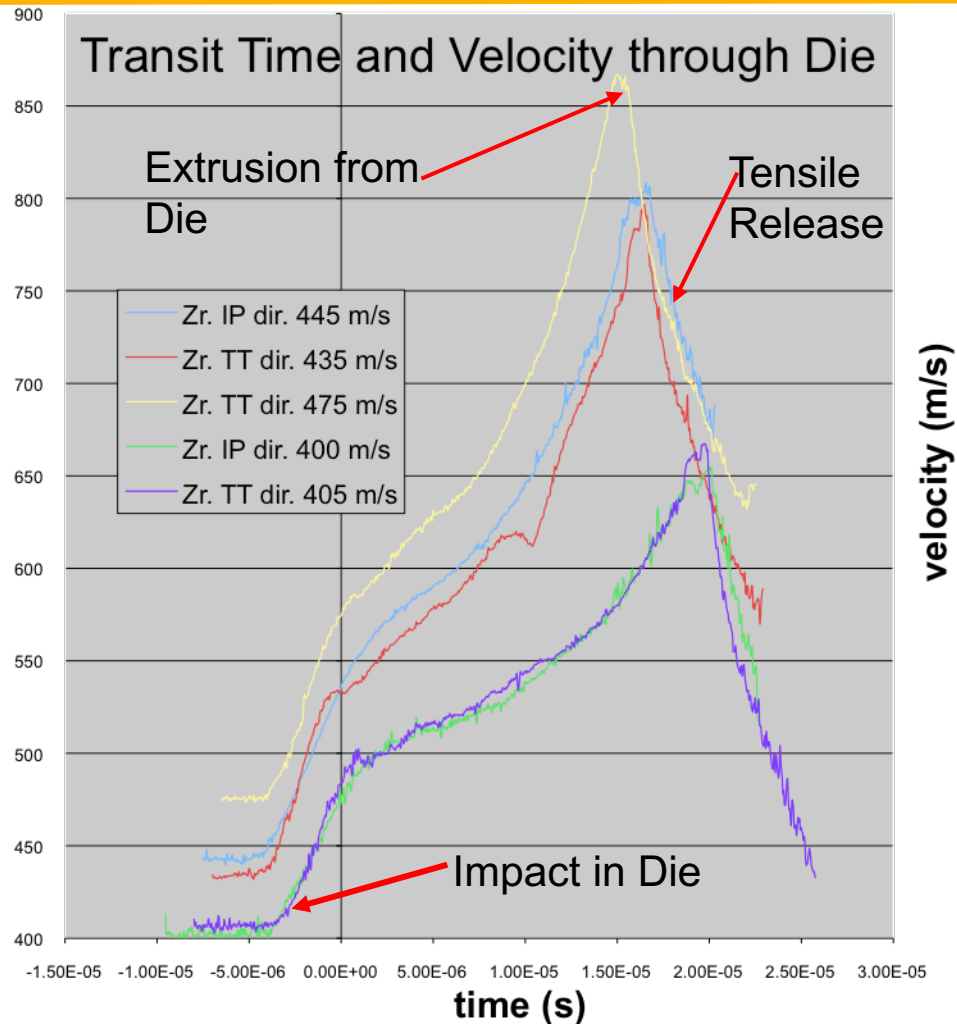


Zr TT dir 435 m/s



Zr IP dir 445 m/s

PDV: Transit Time and Velocity



Results of the PDV Work

- PDV data has reproducibility
- Transit times through die decrease with velocity
- Transit times between TT and IP direction are similar
- Pull back velocity was not anticipated (Future work will capture reversal and terminal velocity, explore transit times through die as a function of temperature)
- Measurements utilized to partition energy during extrusion, based on the time in the die and velocity profile: friction, temperature and kinetic energy can be decoupled with some physical insight