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Title: Zr Extrusion – Direct Input for Models & Validation

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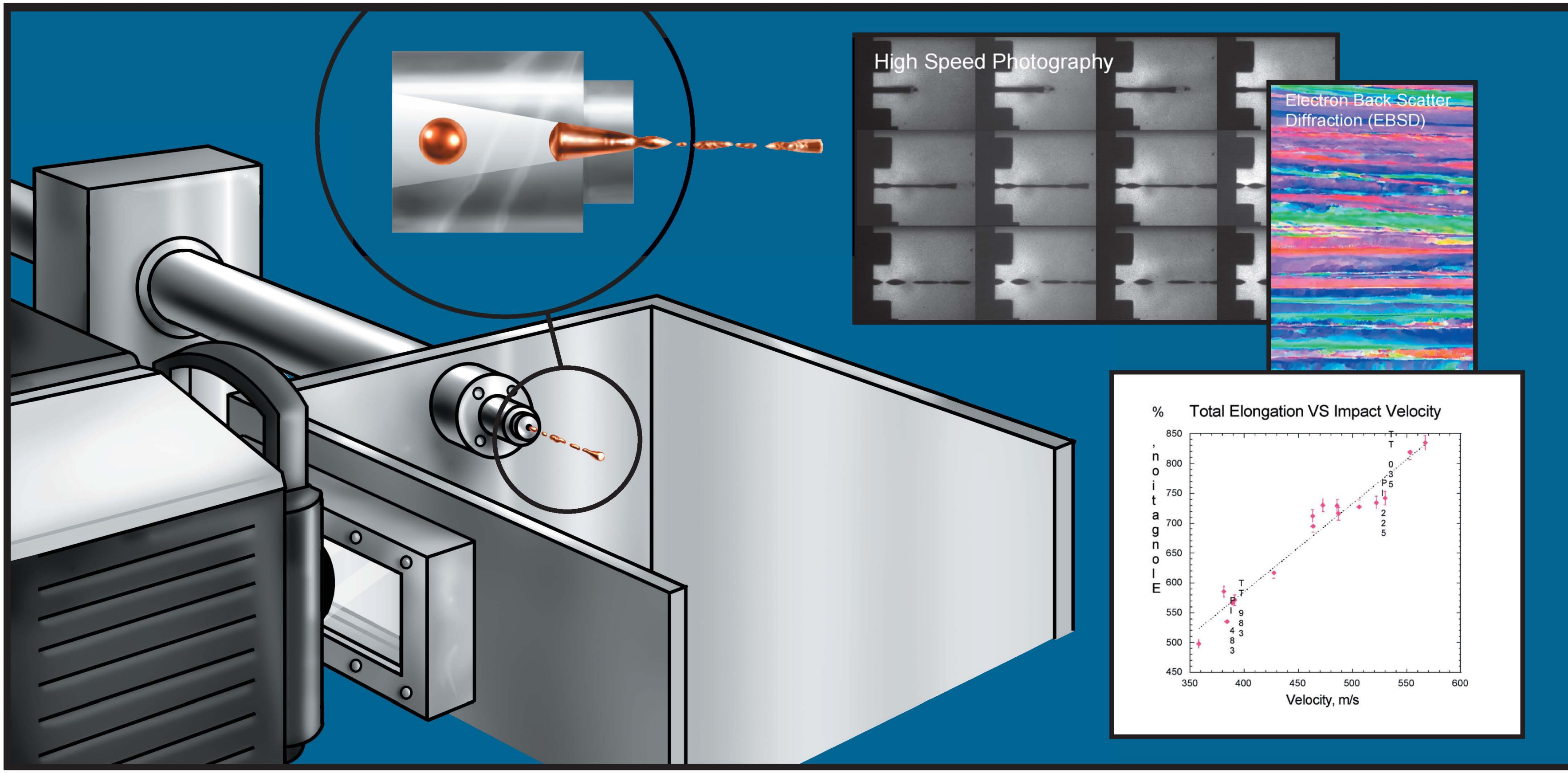
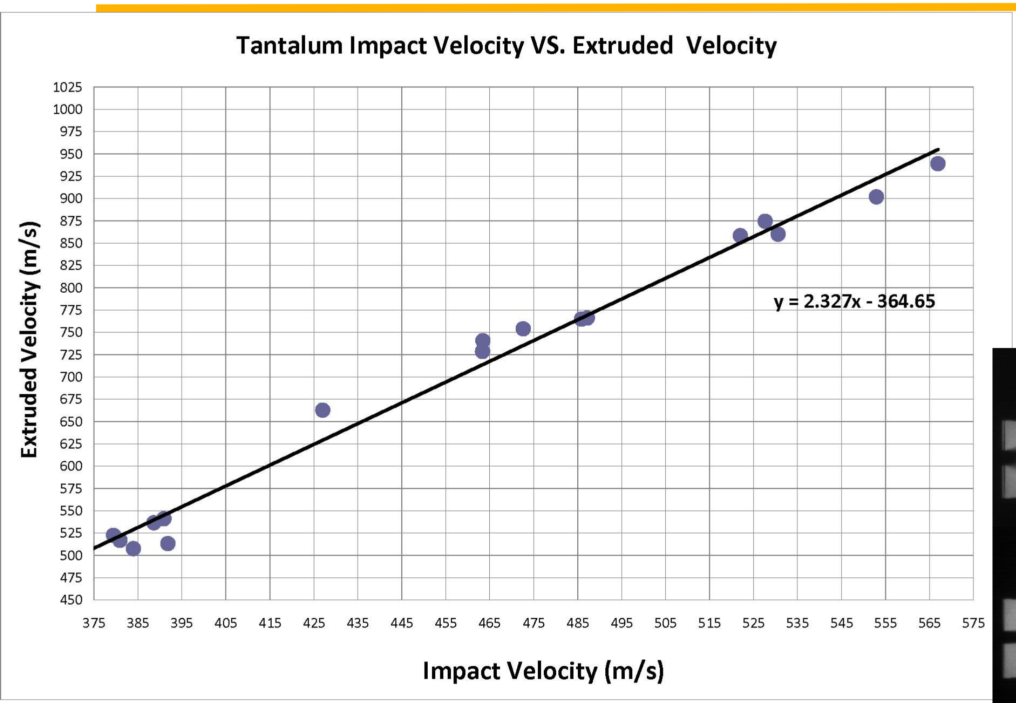
# Zr Extrusion – Direct Input for Models & Validation

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

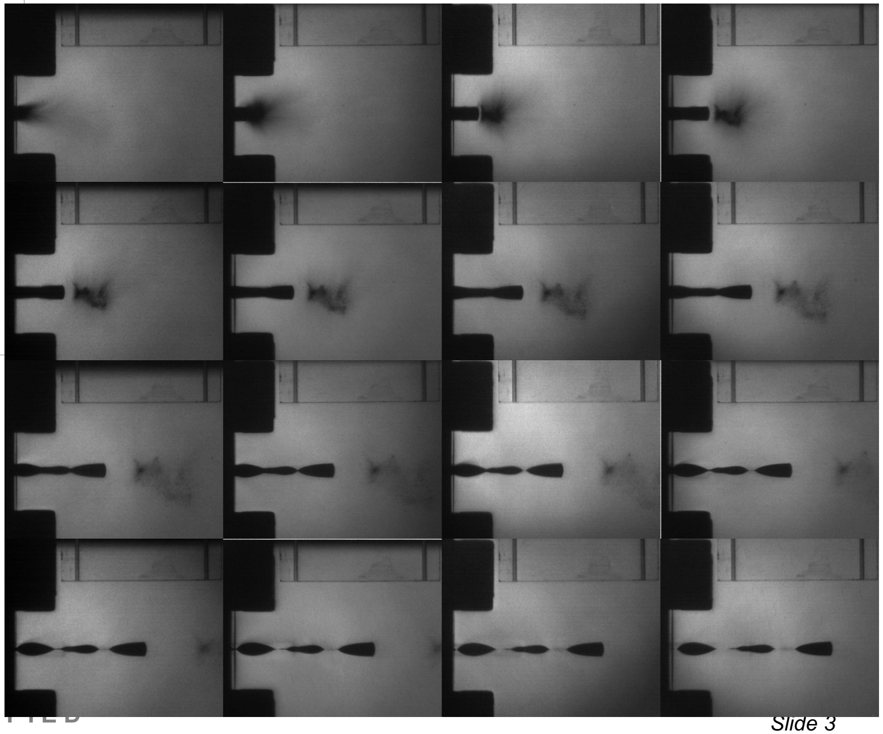
# Schematic Illustration  Showing Dynamic Extrusion and Diagnostics



# Typical Data Generated: Total Elongation, Exit Velocity

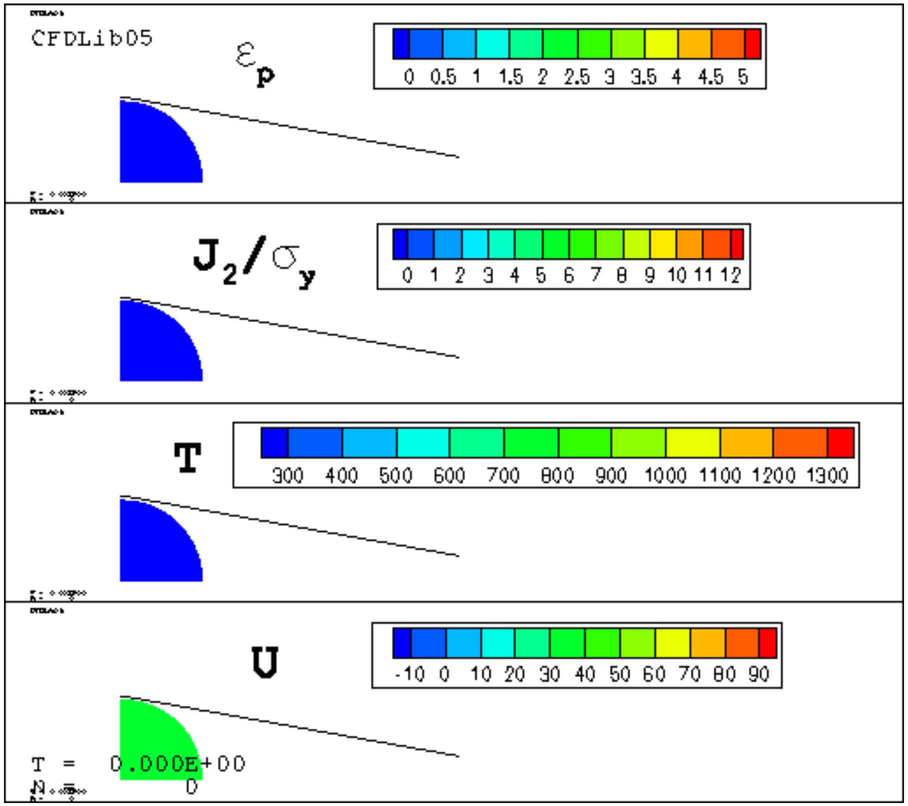



## High Speed Imaging

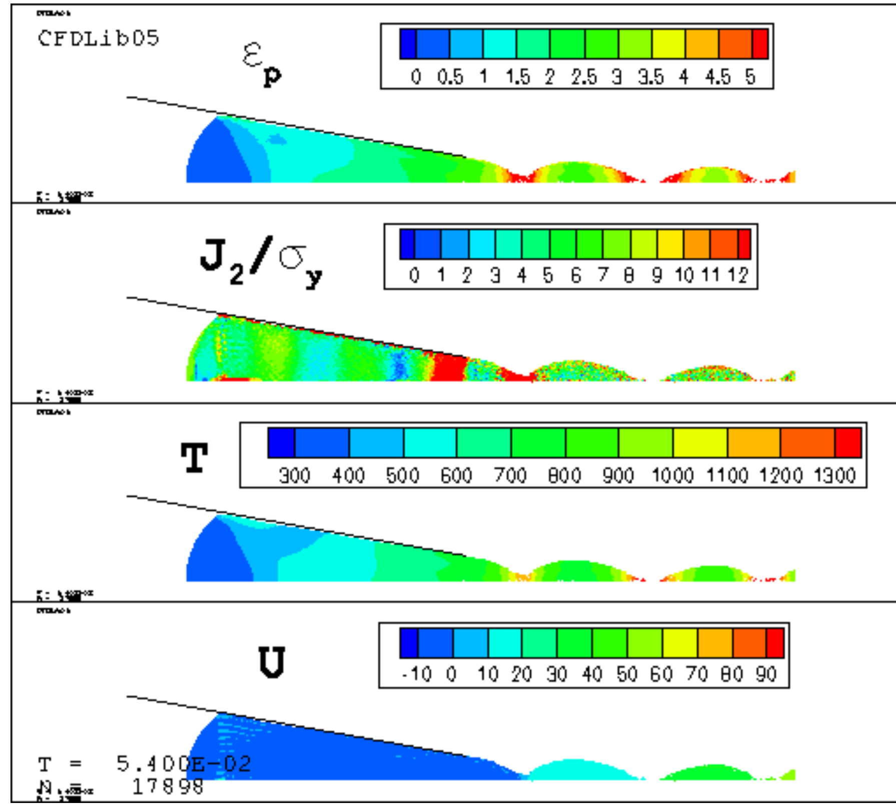


## Elongation as a Function of Velocity

# Uncertainities of the Simulation Influence Predictive Capability

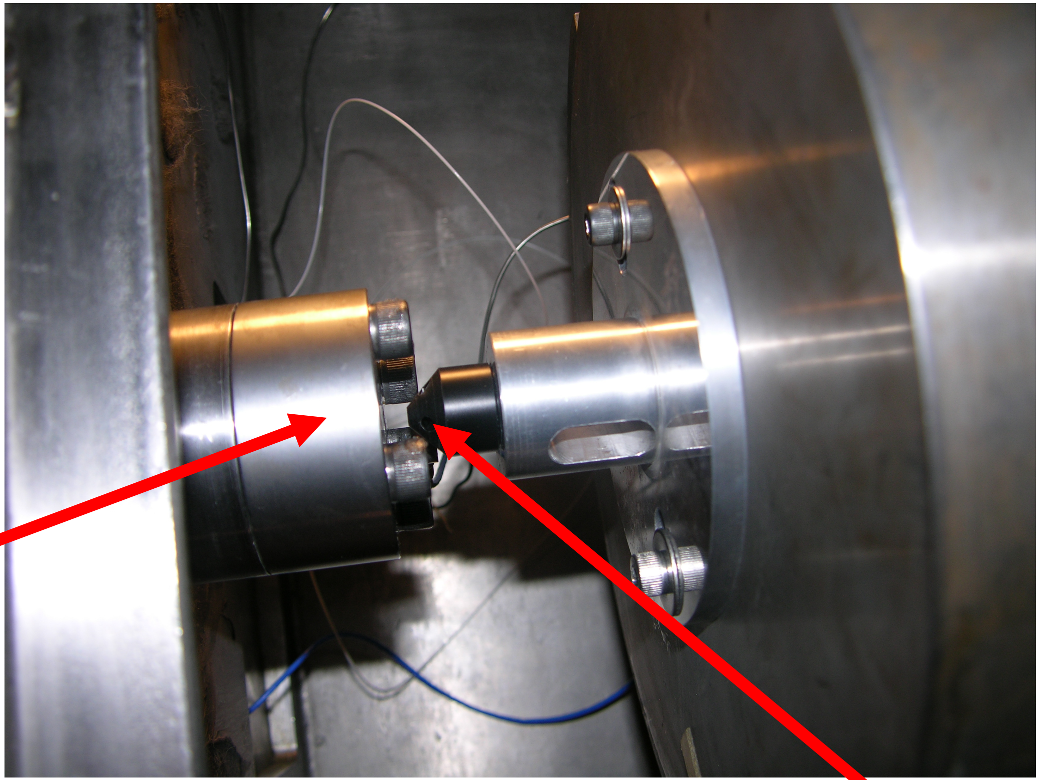



T= 0




T= 0.054ms

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



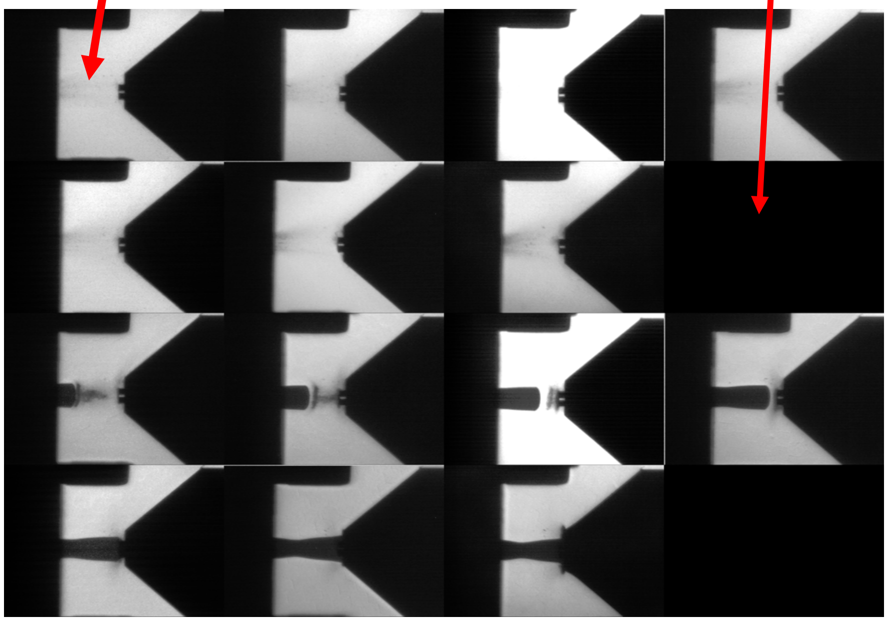
Die holder

PDV Probe holder ½” from exit of die

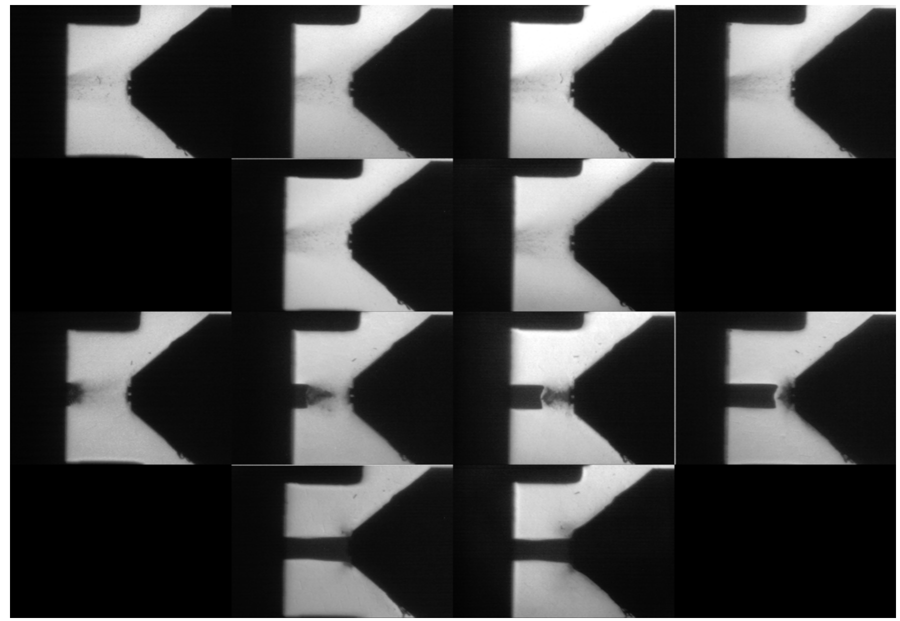
# PDV is Correlated to High Speed Photography

1us after trigger source

15us after trigger source

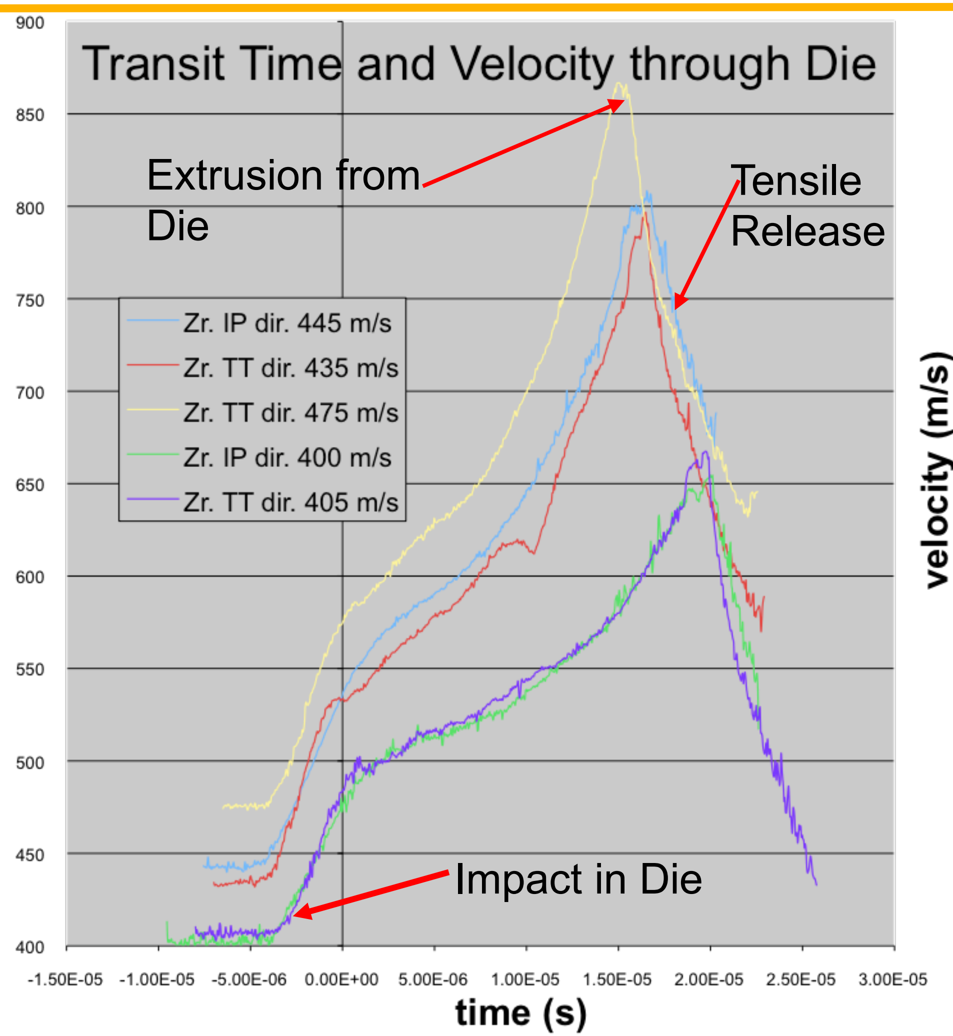


Zr TT dir 435 m/s



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