



Forming of Micro/meso-scale Features with Semisolid Forming



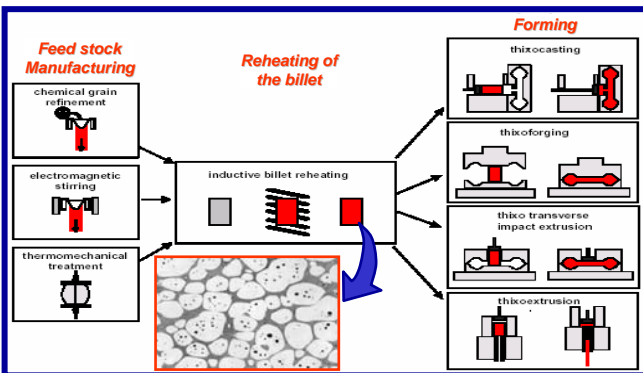
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Objectives

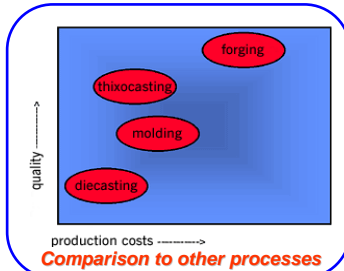
- Investigate feasibility of manufacturing parts with meso-scale features using semisolid forming (SSF) technology.
- Investigate effects of die/punch temperatures and initial workpiece conditions on the forming process.
- Understand complex nature of the material behavior at semisolid state and develop constitutive model.

State-of-the-Art



Typical flow of semisolid forming process

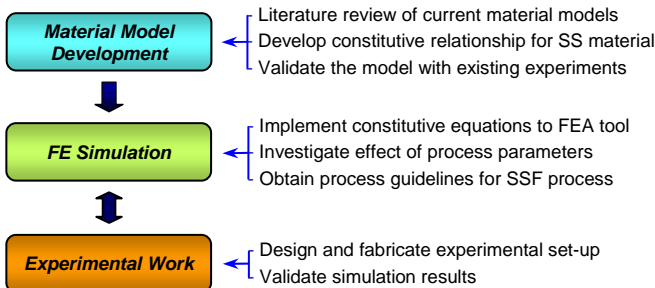
- SSF process has better capability of filling dies with complex geometries with lower punch forces.
- Lower energy consumption and less shrinkage problems compared to casting.



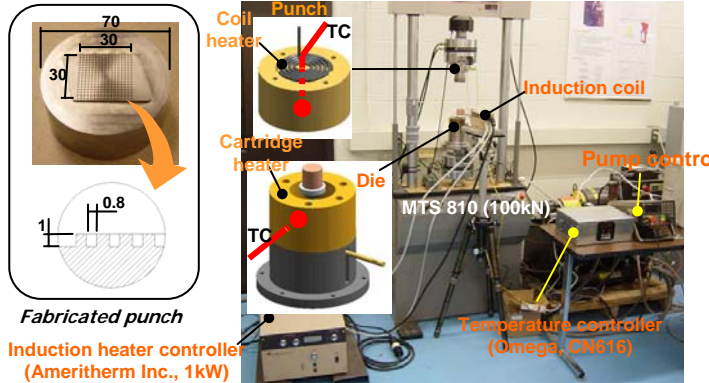
Comparison to other processes

- However, the technology has not yet been applied in the micro-manufacturing area.

Approaches



Accomplishments

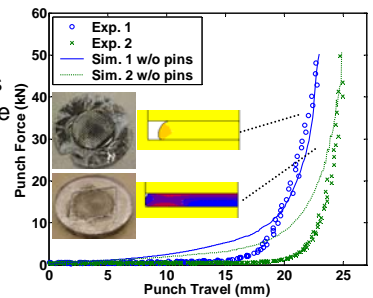


Fabricated punch

Induction heater controller (Ameritherm Inc., 1kW)

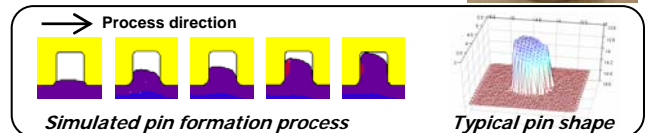
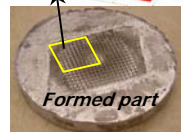
Experimental set-up and punch design

- Developed material model agreed well with the experimental results in terms of predicting the final force and the part shape.
- Lower punch T resulted in incomplete die filling.



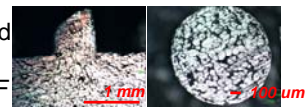
- Pins of the formed part were measured with BIM and reconstructed by MatLab.
- Simulated pin formation process matched well with actual part from the experiment.

Measured pins (BIM)



Future Work

- Investigate effect of grain size and deformation on the micro/meso-feature filling capability of the SSF process



Grain distribution in the part

Sponsors

- U.S. Department of Energy