Computational Techniques for the Design of Material Processes[1]

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During the past decade there have been remarkable developments in the application of computational methods for the optimal design and control of continuum systems governed by partial differential equations. In addition, significant advances in the finite element method for both fluid and solid mechanics applications have increased the utility of computational tools for the modeling of material processes. Some challenging problems in materials processing can now be formulated as optimal design or inverse problems. Optimization based process design provides us with the ability to improve the performance of manufacturing processes. Such applications, for example, include the design of multi-stage deformation processes for shape and microstructure control and the design of solidification processes that result in desired microstructures.

The presentation will highlight some of our recent efforts towards the development of mathematical and computational tools for the modeling, design and control of material processes including solidification, crystal growth and forming processes. To address such design problems, we follow a multidisciplinary approach that includes optimization and control theory, continuum mechanics, computational mathematics, transport phenomena, materials processing, and computer science.

[1]Department of Theoretical and Applied Mechanics, (host: Prof. J. Burns), Ithaca, NY, October 11, 2000.