TIP Project Brief – 090062/10H007

Manufacturing
Integrated Multiscale Modeling for Development of Machinable Advanced Alloys and Corresponding Component Machining Processes

Develop and demonstrate integrated multiscale physics-based predictive modeling for developing more machinable advanced alloys and the corresponding component machining processing data needed by manufacturers.

Sponsor: Third Wave Systems, Inc.
Minneapolis, MN

- Project Performance Period: 2/1/2010 - 1/31/2013
- Total project (est.): $3,170 K
- Requested TIP funds: $1,564 K

Third Wave Systems is working to develop a complex, physics-based predictive modeling system for developing advanced alloys that would incorporate data on how best to machine the planned alloy. This would close a major gap that currently exists in the development and application of new, high-performance metal alloys. Advanced alloy development is an active area of research with pervasive impact within the national economy. Industries benefiting from new alloy development include aerospace (airframes and jet engines), defense and the automotive sector. However, a disconnect exists between alloy developers and the manufacturing base of industries who want to machine advanced alloy components in a fast and affordable manner. Each new alloy presents a new combination of toughness, ductility, heat sensitivity and a variety of other characteristics that need to be considered when the material is machined. Time-to-market advantages are lost while manufacturers struggle with determining machining and other manufacturing factors needed to employ these new, unfamiliar alloys. This project will extend the capabilities of computational alloy design, an emerging approach to alloy development. In current computational design, structure-property models are used to predict an optimal alloy microstructure for a specific set of desired final properties, and process-structure models determine an optimal processing scheme to arrive at that microstructure. What is missing is the incorporation, on the one hand, of machinability considerations into the process plan—an intermediate annealing step, for example, that would make the alloy more workable—and on the other hand, physics-based models that could predict optimum machining parameters like tool speeds and feed rates based on the alloy's microstructure. The project will create a high performance computing environment enabling rapid turnaround for cutting tool design and toolpath development for machined advanced alloy component. If successful, it will enable U.S. manufacturers to produce highly machinable, advanced alloys through the coupling of micromechanical models with physics-based machining models. The results will be applicable not only to machining of advanced alloys, but also to general metal machining.

For project information:
Kate Burke, (952) 832-5515
kate.burke@thirdwavesys.com