Advanced Industrial Materials Program

Project Fact Sheet

Advanced Materials/Processes

Benefits

- Large energy savings in processes including die casting, forging, heat-treating steel sheet and components, and chemical processes
- Life-cycle cost is significantly reduced through improved processes
- Able to selectively apply coatings of carbide and other compositions for wear or corrosion resistance
- Long lasting corrosion resistant high-temperature materials

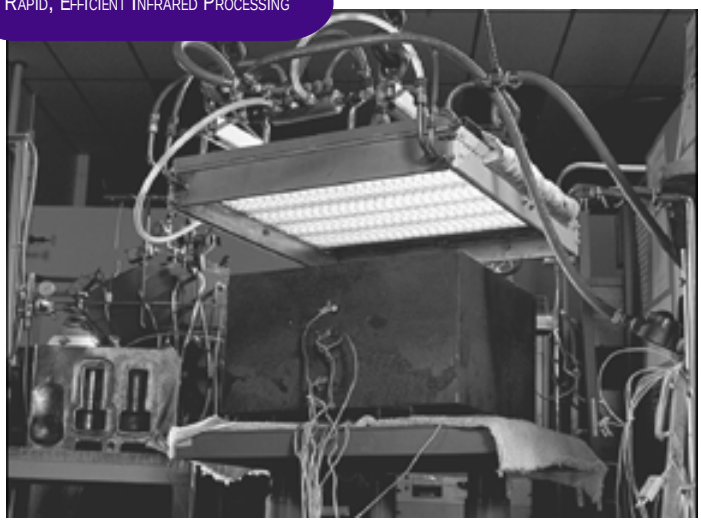
Applications

- Preheating dies prior to forging and die-casting operations
- Selective heat-treating of dies and forged parts
- Wear- and corrosion-protection coatings for use in die casting, forging, and cutting operations
- Iron-chromium-silicon alloys are used in glass-processing operations
- Nickel-molybdenum alloys are finding applications for very corrosive environments such as sulfuric and hydrofluoric acids
- Composites for use in chemical processes

Development of advanced materials and processes can result in large savings in energy and product life-cycle costs for a large number of industries

Manufacturing processes for nearly all industries require materials to perform under demanding conditions of thermal cycling, wear, and corrosive environments. Advanced materials and processes can impact materials needs both within and between industries. The development of corrosion-resistant materials is critical for improving energy and operational efficiencies of many industrial processes and for realizing environmental benefits. Fe-Cr-Si alloys are being developed that have superior corrosion resistance in various applications in the glass industry; new advanced nickel-based alloys and composites have application in many processes in the chemical industry. High energy flux processing, including infrared technologies, can lead to significant efficiency improvements. In applications, including hot forging and die casting, thermal fatigue-related die failure can be minimized by efficient, rapid, reproducible preheating of dies. The wear of components can also be significantly reduced by applying diffusion-bonded coatings of carbides, including WC, Cr_2C_3, or combinations of them. Unique and high-quality coatings can be produced by the use of carbide slurries, carbide felt, and their rapid fusing with high-flux infrared-based heating systems. The combination of advanced materials and process development results in energy and product life-cycle improvements in many industries.

Rapid, Efficient Infrared Processing



Forging and die-casting dies can be efficiently preheated or gradient heat treated by the use of advanced infrared-based heating system

Project Description

Goal: Develop advanced materials and processes in support of improved manufacturing processes for all of the vision industries. Specific developments include infrared-based processing, development of corrosion-resistant Fe-Cr-Si and Ni-Mo alloys, advanced composites, and advanced versions of Alloy 800.

The advanced materials development tasks involve

- Identification of alloy-system or composites for balance of corrosion and strength properties
- Melting and casting process development
- Determination of corrosion and mechanical properties
- Development of welding parameters
- Component fabrication

High-energy flux processing systems including infrared technologies involve the following tasks

- Identification of applications to processing of polymers, plastics, metals and alloys, brazing, and ceramics
- Conduct proof-of-concept experiments for identified applications
- Conduct characterization to demonstrate the benefits of infrared technology
- Develop high energy flux system concepts for applications

Approach: Broaden the industry base for the application of advanced materials and high energy flux processing including infrared technology; identify applications; provide coupons of advanced alloys; and conduct processing experiments to demonstrate suitability in applications.

Potential payoff: The application of advanced alloys and composites have the potential payoff of large savings in energy and costs through improved life cycles for the glass and chemical industries. High energy flux processing including infrared technology has the potential of large energy savings in processes including forging, die casting, and heat-treating of steel. Life cycle costs will also be reduced through improved wear-resistant coatings.

Progress and Milestones

- Prototype components of Fe-Cr-Si are being field-tested in glass manufacturing operations.
- Infrared-based systems are in use for in-line applications for hot- and cold-rolling processes.
- Melted large (500-lb) heats of Fe-Cr-Si alloy and developed initial welding procedure and properties of large heats.
- Demonstrated application of wear-resistant coatings on tool and die components.

Project Partners

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