High-Density Infrared (HDI) Transient Fused Coatings for Improved Wear and Corrosion Resistance

Benefits

The development of the HDI process and equipment for applying improved wear cermet coatings has significant potential to improve the energy efficiency of industrial applications.

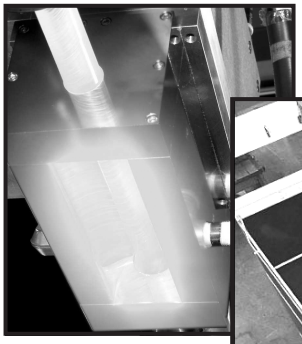
Applications

Cermet wear coatings would offer benefits and energy savings for many applications, across many industries, including the following:

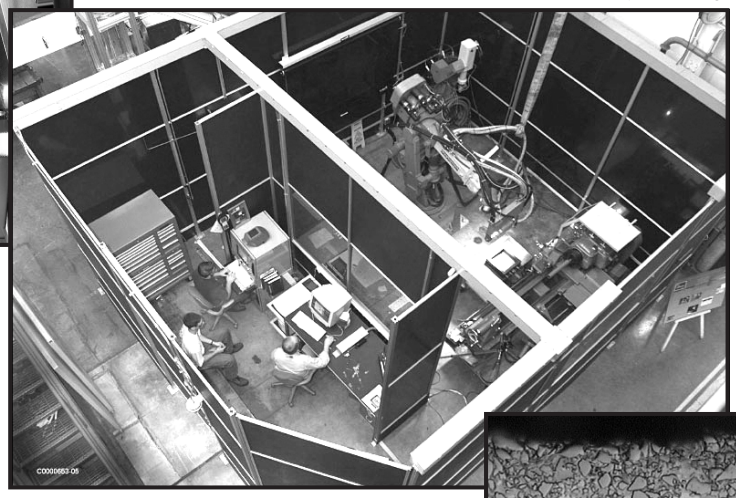
- **Agriculture:** Blades (e.g., cutting corn, harvesting), biomass gasification systems.
- **Aluminum:** Roll coatings.
- **Chemical:** Tubes and pipes.
- **Forest Products:** Harvesters (pinchers), slurry pumps, boilers, corrosion-resistant coatings for gasifier boiler tubes and kraft and biomass gasification systems.
- **Glass:** Transfer lines (wear resistant), cyclones, (corrosion as wear).
- **Metalcasting:** Corrosion-resistant coatings for die casting.
- **Mining:** Earthmoving, material transfer systems.
- **Petroleum:** Pump body housings, pumping slurries (corrosion).
- **Steel:** Boilers, weld overlays (BOF) steel processing and transfer rolls, hot rolling & cold rolling.

The HDI process technology will enable the use of corrosion-resistant and wear-resistant coatings on large industrial processing systems

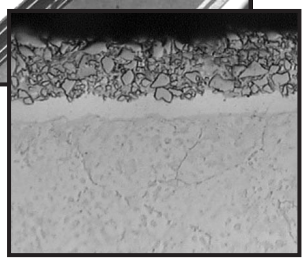
Fused cermet-based thermal spray coatings were introduced over 50 years ago but have seen limited application for larger components because many of those components cannot be subjected to sustained high surface or bulk temperatures (high enough for the required fusion of the coating on the component) of up to 1150°C. The HDI process provides a rapid, localized heating method that can enable the use of advanced fused cermet coatings on large industrial processing systems. The successful completion of this project will enable significant growth of fused-cermet coating technology because only the surface of components are heated sufficiently to fuse and metallurgically bond the coatings to the components. The R&D would also enable development and comparison of new classes of thin fused-cermet/(carbide and other materials) coatings. A successful HDI transient fused coating (TLC) project would enhance the use of fused-cermet coatings for improving the corrosion and wear resistance of materials into more and larger industrial component applications.



Plasma Arc Lamp



ORNL Plasma IR Materials Processing Facility



WC Coating on Steel

The HDI/TLC process utilizes a unique technology to produce extremely high power densities of 3.5 kW/cm^2 using a single lamp that is currently the most powerful in the world. Shown is a 10-micron cermet coating fused with HDI.

Project Description

Goal: The project's aims are (1) to develop, evaluate, and understand how high-density infrared heating technology can improve infiltrated carbide wear coating systems and (2) to better understand the densification and metallurgical bonding within HDI/TLC coatings. A basic understanding of the dilutive mixing of coating with base material is key to successful technology development.

Issues: The materials chosen to be the precursor materials are based in carbide/cermet suspensions or layers. Such coatings have been historically applied to surfaces for wear and corrosion protection via weld surfacing and thermal spray. The issue with weld surfacing is that it can only be accomplished on metals that are not affected negatively by the welding heat effects, the dissolution of the base materials by the weld, and the degradation of second-phase particles. The major issues with the HDI process are heat transfer and how thick of a powder coating can be fused.

Approach: In the proposed work both applied and fundamental investigations will be conducted. The applied work would develop practical HDI/TLC systems that would be capable of fusing carbide coatings for industrial applications. Engineering development would focus on developing the process and equipment technology necessary to implement industrial HDI systems that can fuse coatings on such parts. The fundamental research would be aimed at understanding the effect of HDI processing on the coating materials and the subsequent coating properties. This work would develop the necessary materials and process knowledge to enable the control of the HDI process and the proper specification of coating precursor.

Potential payoff: The successful development of the HDI-TLC coating process for suspension cermet and higher-content cermet thermal spray and fuse coatings would provide an enabling technology for advanced cermet-coating materials systems. This technology, if applied locally and/or just to surfaces, would dramatically improve the commercially available wear coatings that could be used to replace chromium hard coat coatings, nonfused flame spray coatings, and welded hard face surfaces. New coating materials can lead to significant energy savings, productivity increases, and environmental benefits.

Progress and Milestones

- Assessment of industrial coating needs.
- Development of HDI/TLC processing methodologies.
- Process and coating demonstrations on industrial components.
- Testing and evaluation of coatings.

Primary

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Carpenter Powder Products
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