HV Propulsion Materials

High Density Infrared Surface Treatment

Project (PM_10636)

Principle Investigator: Terry Tiegs
Oak Ridge National Laboratory
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OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

UT-BATTELLE

HDIR Surface Treatment

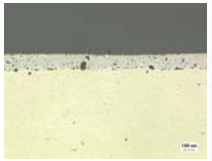
21CTP Technical Goal: **Develop and demonstrate an emissions compliant engine system for Class 7-8 highway trucks that improves the engine system efficiency from ~42% today to 50% by 2010.**

Project Objectives
Use High Density Infrared (HDI) technology to produce wear and corrosion resistant coatings on iron-based materials for heavy-duty vehicle applications.

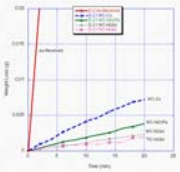
FY 2005 Focus
Coatings based on hardmetal compositions applied onto iron-based parts appear to have the best potential for use in heavy-duty vehicles.

Planned Duration
October 2003 to September 2005

DOE Funding/Industry Cost Share
FY04: $70K; FY05: $70K



WC/Ni_3Al coating on D2 tool steel



Wear resistance significantly improved

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Accomplishments
1. Refined processing of hard metal coatings. (September 2004)
2. Demonstrated improved wear resistance for hard metal coatings on cast iron, low alloy steel and tool steel. (September 2004)

Significant Future Milestones
1. Complete Investigation of the relationship between processing parameters, microstructural development, and wear resistance. (September 2005)

Project ID/Agreement ID	Program Structure	Sub-Program Element	R&D Phase	Date
PM_10636	Materials Technology	HV Propulsion Materials	Applied Research	8-11-05

Objectives

- **Use High Density Infrared (HDI) technology to produce wear and corrosion resistant coatings on iron based materials for heavy-duty vehicle applications**
- **Determine the relationships between processing parameters, microstructural development, and wear resistance**
- **Investigate non-line-of-sight coatings for application on complex-shaped heavy-duty vehicle parts, such as gears**

Relevance to 21CT Goals

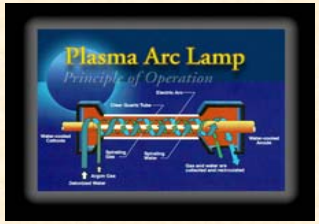
- Develop and demonstrate an emissions compliant engine system for Class 7-8 highway trucks that improves the engine system efficiency from ~42% today to 50% by 2010

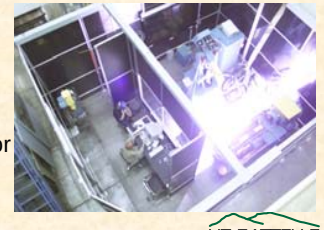
Technology Transfer

- Project in second year
- Presentations made at several conferences reporting the results
- Discussions ongoing with diesel engine manufacturers concerning cooperative work

Approach

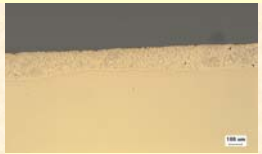
- In most cases, the need for wear resistance or corrosion resistance is only necessary in selected areas of the part that is exposed to the working environment or under high stress
- Therefore, it is desirable to use materials that are lighter or less expensive for the bulk of the part and only have the appropriate surface properties where required
- Coatings based on hardmetal compositions applied onto iron-based parts appear to have the best potential for use in heavy-duty vehicles



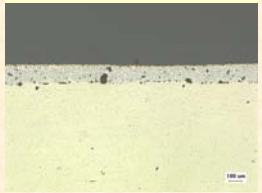


Technical Accomplishments/ Progress/Results

Typical Coating Microstructures

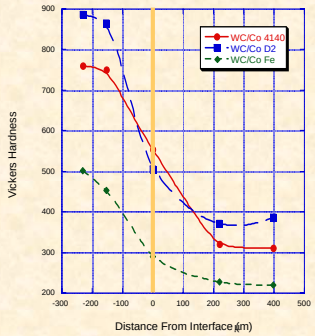


WC/Ni coating on 4140 steel



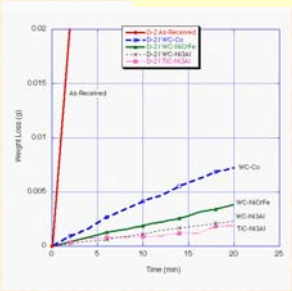
WC/Ni_3Al coating on D2 steel

Surface Hardness Improved

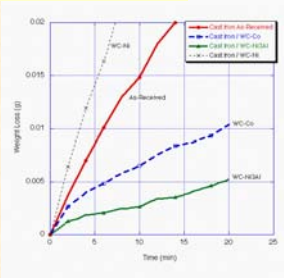


Technical Accomplishments/ Progress/Results

Wear Resistance Improved



D2 Tool Steel Substrate



Cast Iron Substrate

Dry sliding conditions using a block-on-disc tribometer
Coating with Ni_3Al as binder exhibited best wear behavior

Future Work

- Refine processing of hard metal coatings
  - IR parameters and coating composition
- Fabricate WC-cast iron composites
  - Other work identified these as economical and wear resistant compositions
  - Fabricate by IR treatment of painted surface coating with WC
- Investigate non-line-of-sight coatings for application on complex-shaped heavy-duty vehicle parts, such as gears
  - Examine the potential to produce wear resistance diffusion coatings by microwave pack cementation