



... for a brighter future

Low-Friction Hard Coatings

Ali Erdemir (PI)

Osman Eryilmaz (Co-PI), Oyelayo Ajayi (Co-PI)

Argonne National Laboratory

May 19, 2009



U.S. Department
of Energy



A U.S. Department of Energy laboratory
managed by The University of Chicago

Project ID #
vssp_04_erdemir

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Overview

Timeline

- Start: 10/01/2006
- Finish: 09/30/2010
- %75 Complete

Budget

- Total project funding
 - DOE - \$325K
- Funding received in FY08 - \$125K
- Funding received in FY09 - \$100K

Barriers

■ Barriers addressed:

- Component and system performance is too low
- Safety, durability, and reliability
- Higher vehicular operational demands

■ Target:

- Select surface modification technologies and optimized lubricant-surface interactions to achieve superior efficiency and durability.

Partners

- Galleon International – Technology Maturation
- Hauzer Techno Coating – Coating process development and scale-up
- Lead: Argonne National Laboratory

Objectives

- **Design, develop, and implement superhard and low-friction coatings to increase durability, fuel economy, and environmental compatibility of engine systems.**
- **Demonstrate commercial-scale production of such coatings.**
- **Characterize and verify performance through bench-top and engine studies.**

Milestones or Go/No-Go Decisions

■ FY08:

- Go/No-Go Decision: Completion of bench-top testing and component level studies

■ FY09:

- Go/No-Go Decision: Demonstrate feasibility of larger scale deposition. Demonstrate performance by field testing in fired engines.
- Go/No-Go Decision: Complete scale-up and field studies. Demonstrate cost competitiveness.

Approach

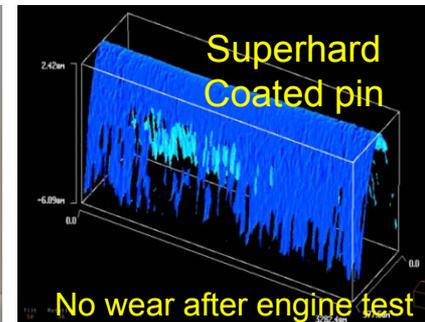
- **Optimize deposition parameters that are most effective in physical, mechanical, and tribological properties of nanocomposite coatings**
 - Superior bonding and surface smoothness
 - Super-hardness and -low friction
 - Extreme resistance to wear and scuffing
- **Demonstrate large-scale production and cost competitiveness.**
- **Demonstrate reliability and performance in engine applications.**

Technical Accomplishments/Progress/Results

- Deposition of optimized coatings on actual engine components with strong bonding and surface smoothness in a commercial-scale deposition system at Hauzer Techno Coating Company.
- Verification of their superior mechanical and tribological properties by bench-top studies.
- Completion of initial screening tests by engine company partners.
 - Compared to 2008 activities, in 2009 most of our attention has been shifted to scale-up and field testing of optimized coatings and validation of their performance and durability in actual engines.

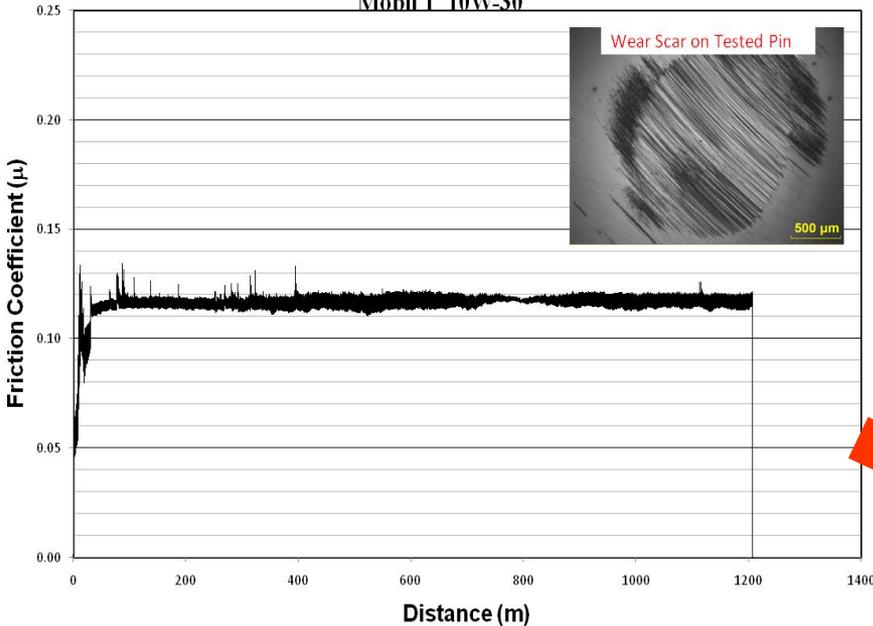


Piston Pin



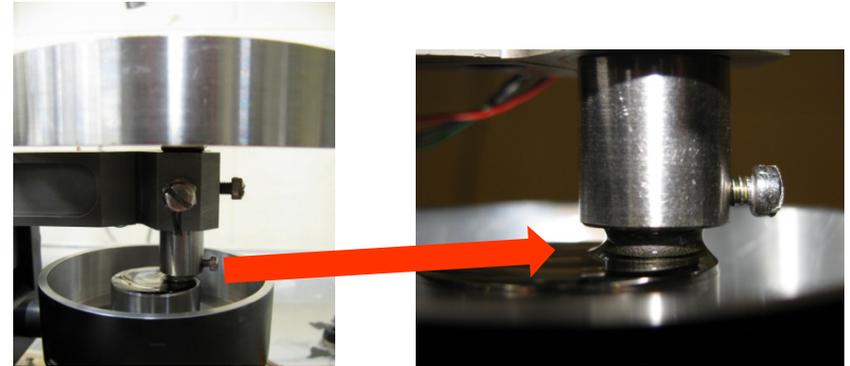
Technical Accomplishments/Progress/Results

SHC Coated Tappet vs Pin 20 N load, 10 rpm, 19 mm track diameter,
Mobil 1 10W-30

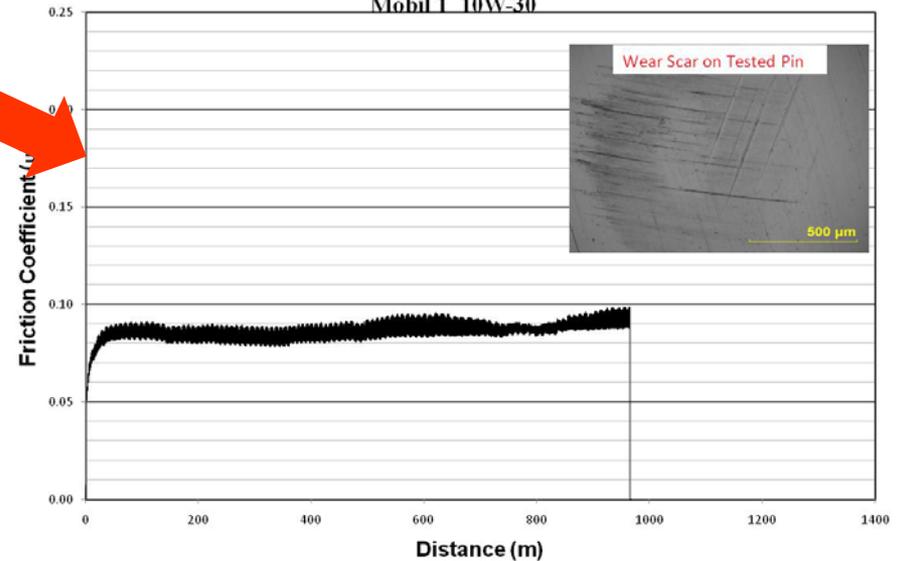


Pin on Disc Test on Initially SHC Coated Tappet (Year 2008)

There is a significant reduction in both the **friction** and **wear** of coated **tappets** through deposition process optimization over the last year.



SHC Coated Tappet vs Pin 20 N load, 10 rpm, 19 mm track diameter,
Mobil 1 10W-30



Pin on Disc Test on Recently SHC Coated Tappet (Year 2009)

Technical Accomplishments/Progress/Results

■ Scale-up and Commercialization

- Working with Galleon International and Hauzer Techno Coating (one of the largest industrial coating companies), in FY2009, we concentrated on scale-up and production of these coatings on tappets, piston pins, piston rings, and fuel injectors for testing by many companies.

■ Technology Transfer

- Galleon International initiated licensing talks with Argonne to commercialize the technology



Future Work

- Validate **production** of optimized coatings in the **commercial-scale deposition systems** of our coating partner (Hauzer) (FY2009).
- Validate their **durability and performance under actual engine conditions** (motored/fired) (FY2009).
- Concentrate on **technology transfer and commercialization** (FY2010)
 - Increase collaboration with industrial partners
 - Demonstrate cost-competitiveness and benefits
 - Finalize licensing talks and commercialize the coatings.

Summary

- Successfully demonstrated the production of superhard and low friction coatings using lab- and – commercial-scale deposition systems.
 - By virtue of their superhardness, these coatings prevented wear and scuffing failures in piston pins and tappets.
 - Because of their low-friction character, they can increase fuel economy of future engines.
 - Less fuel consumption means less green-house and other hazardous gasses released to environment.
 - These coatings are applicable to numerous engine components (can also be used in manufacturing for machining, metalforming, etc.)
- Technology transfer and commercialization efforts are currently underway and will further intensify in 2010.