NATIONAL SCIENCE FOUNDATION I/UCRC

FOR LASERS AND PLASMAS FOR ADVANCED MANUFACTURING

SMU's Site Center Progress Report
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MEMBERSHIP STATUS

1. **The Army Research Laboratory,** Aberdeen Proving Ground, MD
2. **General Motors Corp., Detroit, MI**
3. **Lockheed Martin Missiles and Fire Control, Dallas, TX**
4. **Halliburton Energy Services, Carrolton, TX**

UNDER DISCUSSION:

1. **Bell Helicopter TEXTRON, Fort Worth, TX**
2. **Boeing, Phantom Works, St. Louis, MO**

- The US Department of Education is funding four Ph.D. fellowships in the area of lasers and plasmas for advanced manufacturing with $168,896 per year, for three years, starting from Aug. 2006.

- HAAS Automation Inc., Oxnard, CA, Donated a five-axis high-speed CNC vertical machine to the center in the value of $138,608. The machine will be a part of the new multi-fabrication system for rapid manufacturing and repair.

NEW FUNDING:

1. **Kovacevic, R., "Development of Plasma Shielding Instrumentation Enabling Electron Beam Materials Processing in Air", the NSF, Washington, D.C., DMI-0619776, $484,985, Sept. 1, 2006 – Aug. 31, 2009.**
2. **Kovacevic, R., "Graduate Assistance in Areas of National Need: Lasers and Plasmas for Advanced Manufacturing", US Department of Education, PR/Award # P200A060216, $168,896, August 2006 – July 2007.**
3. **Kovacevic, R., "Establishment of the Manufacturing Research Center", NASA/Goddard Space Flight Center, Greenbelt, MD, $ 919,692, Oct. 1, 2006- Sept. 30, 2008**
4. **Kovacevic, R., "Collaborative Research Proposal for Industry/University Cooperative Research Center for Lasers and Plasmas for Advanced Manufacturing", second year, NSF, Washington D.C., EEC 0541952, $ 50,000, Sept.1, 2006- Aug. 31, 2007.**

PRE-PROPOSALS SUBMITTED:

1. **Kovacevic, R., Gupta, M., Mazumder, J., Yao, L., and Craft, W., "IGERT: A Global Multi-university/industry IGERT Program in Laser Materials Processing", the NSF, Washington, D.C., submitted on April 5, 2007.**

PUBLICATIONS:

Journal Papers:

1. Fan, H.G. and Kovacevic, R., "**Three-Dimensional Model for Gas Tungsten Arc Welding with Filler Metal**", accepted for the Proceedings of the Institution of Mechanical Engineers, Part B, *Journal of Engineering Manufacture*
2. Zekovic, S., Dwivedi, R., and Kovacevic, R., "**Numerical Simulation of Gas-powder Flow from Radially Symmetrical Nozzles in Laser-based Direct Metal Deposition**", the *International Journal of Machine Tools and Manufacture*, 47 (2007) 112 – 123.
3. Jiang, W.H. and Kovacevic, R., "**Laser deposited TiC/H13 Tool Steel Composite Coatings and their Erosion Resistance**", the *Journal of Materials Processing Technology*, 186 (2007), pp. 331-338.
4. Dwivedi, R., Zekovic, S., and Kovacevic, R., "**A Novel Approach to Fabricate Uni-Directional Branching Slender Structures Using Laser-based Direct Metal Deposition**", the *International Journal of Machine Tools and Manufature*, 47(2007), pp. 1246-1256.
5. Dwivedi, R. and Kovacevic, R., "**An Expert System for Genera tion of Machine Inputs for Laser-based Multi-directional Metal Deposition**", the *International Journal of Machine Tools and Manufacture*, 46 (2006), pp. 1811-1932.
6. Yarrapareddy, E., Zekovic, S., Hamid, S., and Kovacevic, R., "**The Development of Ni-Tung Functinally Graded Materials by Laser-based Direct Metal Deposition Process for Industrial Slurry Erosion Applications**", the Proceedings of the Institution of Mechanical Engineers, Part B, the **Journal of Engineering Manufacture**, Vol. 220,(2006), pp. 1923-1936.

Conference Papers:

1. Yarrapareddy, E. and Kovacevic, R., "**Nano Materials System Development by Laser Based Direct Metal Deposition Process for Industrial Slurry Erosion Applications**", TMS 2007: Linking Science and Technology for Global Solutions, Febr. 25-March 1, 2007, Orlando, FL.
2. Dwivedi, R. and Kovacevic, R., "**Multi-fabrication as a Base of Rapid Manufacturing**", The *15th International Symposium on Electro-machining*, April 23-27, 2007, Pittsburgh, PA.
3. Atharifar, H. and Kovacevic, R., "**Computational Study of material Flow and Tool Load Coefficients During Friction Stir Welding**", 2007 GSRIC Proceedings *ASME Gradute Student Research & Innovation Conference*, Hosted by ASME District E, April 13 – 14, 2007, Tulsa, OK

PROJECT SELECTED BY THE BOARD

1. **Creation and Testing of FGM for Slurry Erosion Resistance by Laser Cladding, Halliburton Energy Services**

2. **Feasibility Study of Laser Welding of Advanced Lightweight Materials, General Motors Corp.**

PROPOSALS UNDER PREPARATION

1. **Feasibility study of using variable polarity plasma welding for repair of high-value Al-parts, Lockheed Martin**

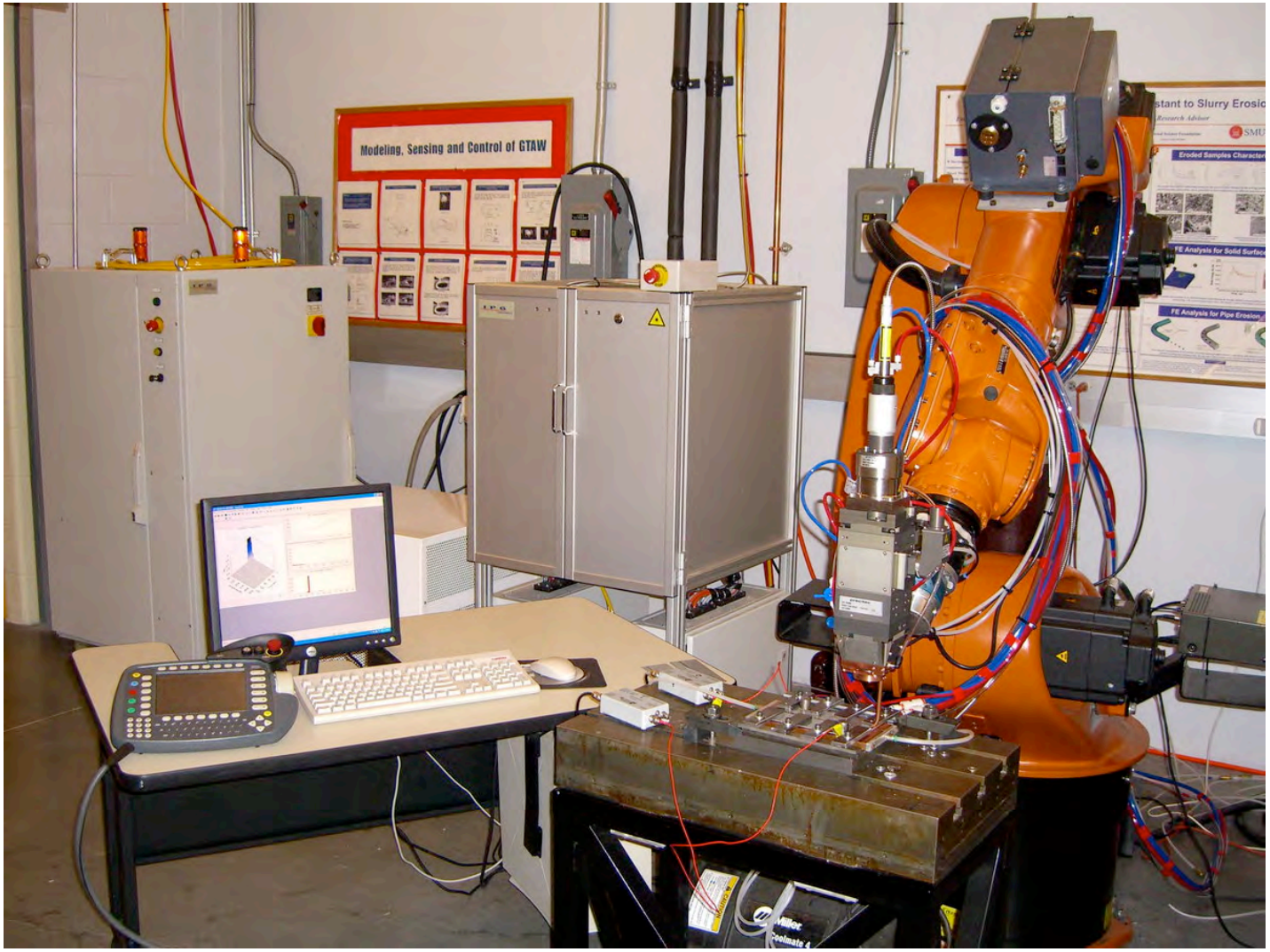
2. **Advanced precision supply parts manufacturing by electron beam melting® Army Research Laboratory**

Current Research Directions

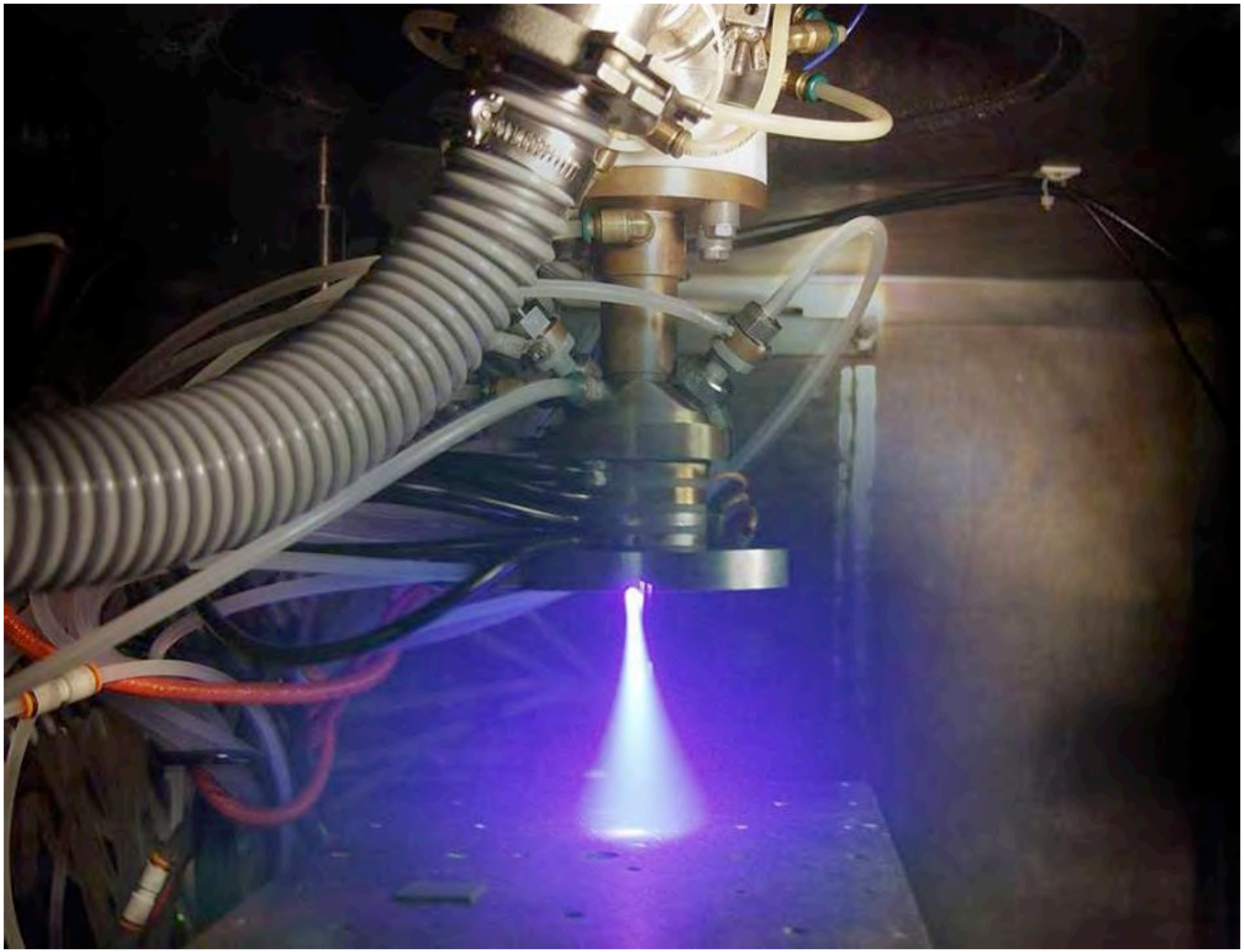
- Multi-fabrication Manufacturing/Repair Concept
- Application of High Power Fiber Laser in Materials Processing
- Shielding Electron Beam by Plasma Arc
- Variable Polarity Plasma Welding/Repair for Al-alloys
- Paint Stripping by a Fiber-coupled Diode Laser
- Heat Treatment by a High-power Direct Diode Laser
- Advanced Precision Supply parts Manufacturing by Electron Beam Melting ®

MultiFab System-based on 1kW Nd-YAG laser

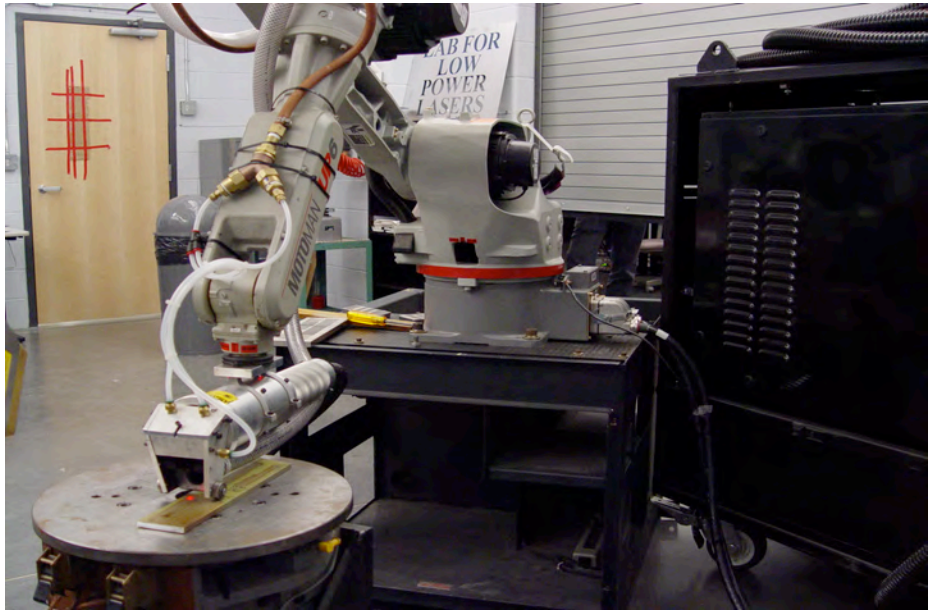
Robotized 4kW Fiber Laser Cell



The Plasma-Shielded Electron Beam in Drilling Hole in Air

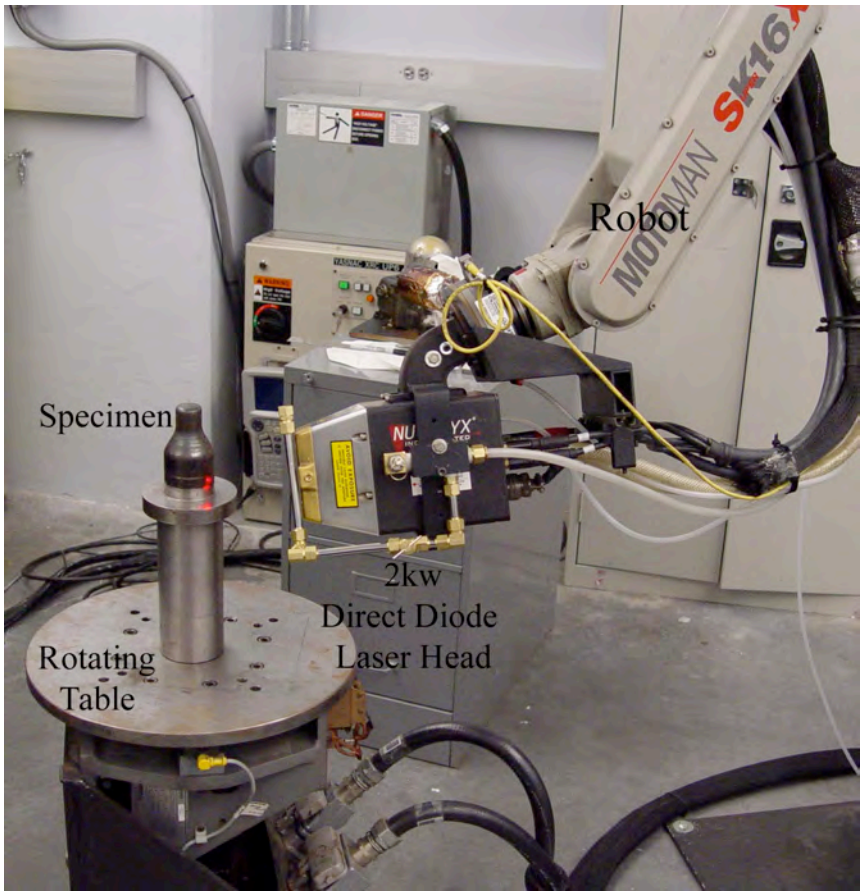


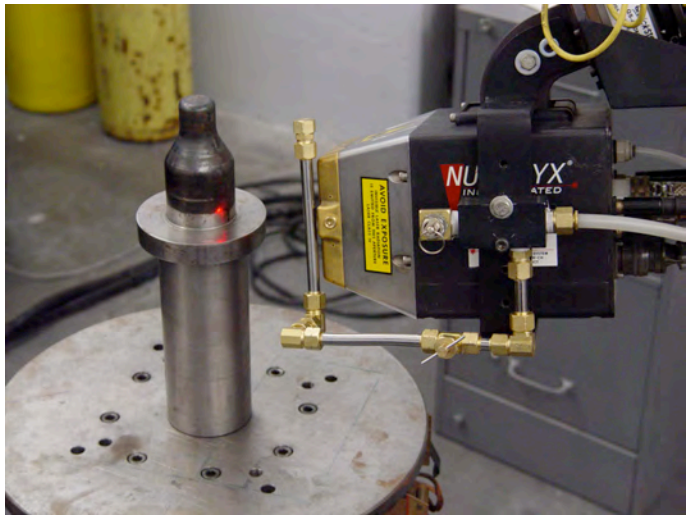
Laser De-coating by a 1 kW Fiber-coupled Diode Laser



- Removal of coatings on painted 2024 and 7075-T6 Al of 1.2 mm thickness, by a 1 kW Fiber-coupled Diode Laser
- Modeling heat transfer from laser to coatings and substrate
- Minimizing the damage to substrate
- Monitoring removal process

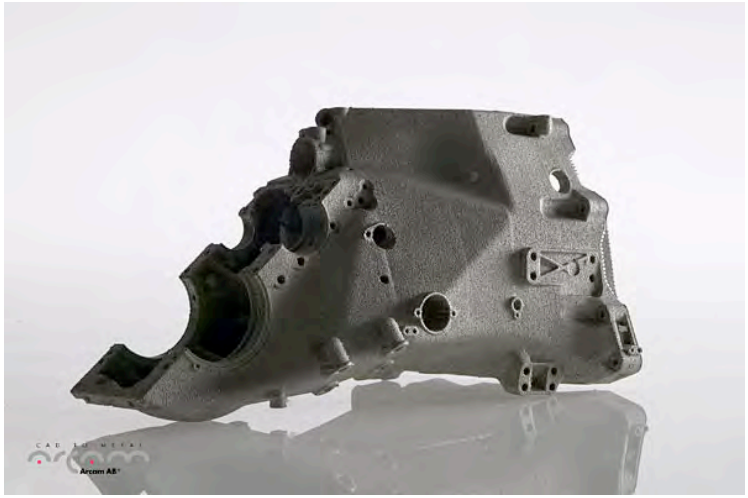
Surface Heat Treatment by Direct Diode Laser





- Heat transfer Modeling to optimize the process parameters
- Sensing the temperature and control of the heat treatment depth
- Off-line programming of robot for complex configurations

Components built by Electron Beam Melting ®, made of Ti_6Al_4 and Cobalt-Chromium Alloy



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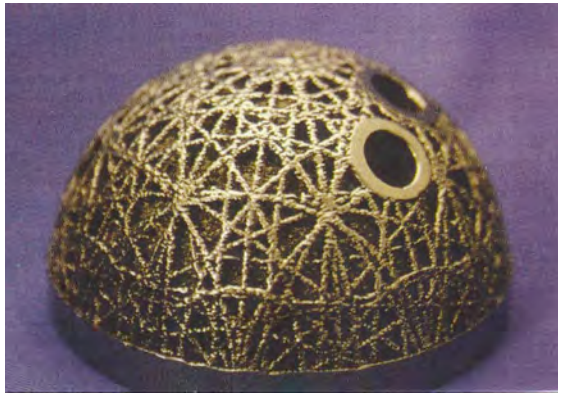
Components with biomedical application produced by Electron Beam Melting®



Acetabular cup produced in Ti6Al4V-ELI showing a complex backing design (www.orthosupplier.com)

Model of spine showing a lattice cage implant produced using EBM technique (www.orthosupplier.com)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Thank you