

Laser Powder Deposition (LPD) Processing

- **Trumpf 3 kW Nd:YAG Laser**
- **Fanuc M16i Robot**
- **CAD/CAM 3 Axis Gantry**
- **Four Metal Powder Feeders**
- **Labview Melt Pool Controller**
- **Process Sensors**
 - **Melt Pool (CID camera)**
 - **Build Vision (CCD camera)**
- **Non-Contact NDT**
 - **Acoustic Emission**
 - **Laser Ultrasonics**
- **Containment & Gas Recirculation**
- **Power Meter**
- **Annular and Discrete Powder Delivery**





Laser Powder Deposition Processing

- **Functionally Gradient Materials for Molds and Dies**
 - Dr. Stan Howard, Met - Metallurgical Thermodynamic Modeling
- **Laser Deposition Fabrication Issues for Ultra-Light Weight Mirrors for Space Applications (SiC/Si & NiTi)**
 - Dr. Chris Jenkins, ME – Ultra-Light Weight Structural Analysis
- **Repair of Army Combat Vehicles**
 - Dr. James Sears, IMM – Laser-Material Processing
 - Dr. Michael Langerman, ME – Modeling Heat Transfer
 - Dr. Vojislav Kalanovac, ME – Process Control & Robotics
 - Dr. Gregory Buck, ME – Modeling Fluid Flow
 - Dr. Karmin Mucci, ME – Structural Analysis
- **Conformal Cooling for Plastic Injection Mold Tooling**
 - Dr. Daniel Dolan, ME – Structural Analysis



Laser Powder Deposition Processing

Current Projects

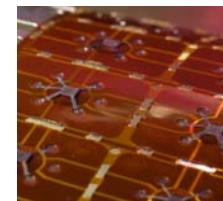
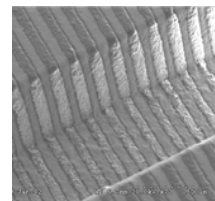
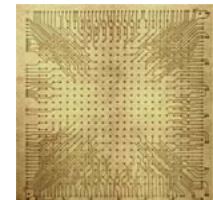
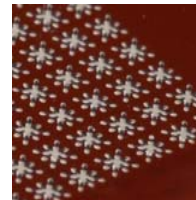
- **Functionally Gradient Materials for Molds and Dies**
 - US Department of Energy (\$600K – 3 years)
- **Laser Deposition Fabrication Issues for Ultra-Light Weight Mirrors for Space Applications (NiTi)**
 - US Air Force Research Laboratory (\$400K)
- **Repair of Army Combat Vehicles**
 - US Army Research Laboratory (FY-04 \$400K, FY-05 \$100K)
- **Conformal Cooling for Plastic Injection Mold Tooling**
 - Advanced Tooling (ATi), Blaine, MN (\$5K)
- **LPD Processing of Ti-6-4**
 - Keystone (\$10K)
- **Applying Wear Coatings**
 - TORO (\$32K)
- **LPD Processing of Ta**
 - H. C. Starck (\$10K)
- **Applying Ta as a Hermetic Seal Coating**
 - Exothermics, Inc (\$1.5K)

Direct Write Deposition Processing

- Detonators: Plan is to provide a robust solution for detonators for Army applications.
- Legacy Electronic Circuit Repair: Legacy systems have obsolete circuitry that is difficult to repair and maintain.
- Exhaust Temperature Sensors: Provide micro-thermal sensors that can be directly written on to turbine and engine exhausts surfaces with wireless transmission to a central control system to help monitor fuel efficiency.
- Micro-vibration sensors: Provide a vibration sensor that can be written internal to a helicopter gearbox to help predict premature failure.
- Nano-particle Ink Development: This program will provide improved material performance (conductivity, permeability, adhesion, strength and ductility) for the support projects.
- Particle Formation Kinetics: Chemistry of Suspensions, Aerosol Formation, and Characterization of M³D Deposited Patterns to provide understanding of M³D atomization for process optimization.



M³D Production Samples
Maskless Mesoscale Materials Deposition





Direct Write Deposition Processing

- **Direct Write Fabrication for Ultra-Light Weight Mirrors for Space Applications (Nano-Laminates)**
 - Dr. Chris Jenkins, ME – Ultra-Light Weight Structural Analysis
- **Establishment of a Direct Write Laboratory for DoD Applications**
 - Dr. James Sears, IMM – Deposition Processing
- **Development of Conformal Antennas Constructed by Direct Write Processing**
 - Dr. Keith Whites, EE, Antennas and Electronic Devices
- **Restorative Injury Repair (RIR) Program**
 - Dr. James Sears, IMM – Deposition Processing
- **Direct write explosive technologies for MEMS and MEI applications**
 - Dr. James Sears, IMM – Deposition Processing



Direct Write Deposition Processing

- **Direct Write Fabrication Issues for Ultra-Light Weight Mirrors for Space Applications (Nano-Laminates)**
 - US Air Force Research Laboratory – Funded - \$400K
- **Establishment of a Direct Write Laboratory for DoD Applications**
 - US Army Research Laboratory – Funded - \$750K (FY-04)
 - US Army Research Laboratory – pending - \$800K (FY-05)
- **Development of Conformal Antennas Constructed by Direct Write Processing**
 - US Army Research Laboratory – Funded - \$200K (FY-04)
- **Restorative Injury Repair (RIR) Program**
 - DARPA – Submitted by SDU ~ \$1800K/2years - Pending
- **Direct write Explosive technologies for MEMS and MEI applications**
 - US Army – ARDEC - \$200K – Pending (FY-05)