

# US Army Research Laboratory

## CSAT Meeting June 23-24, 2015



Engineer

Technician

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Sales



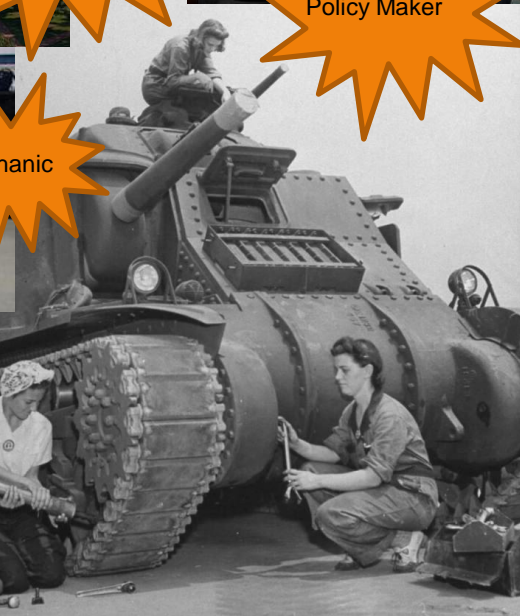
Academia



Policy Maker



Mechanic



Research



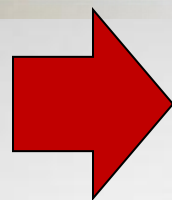
Manager



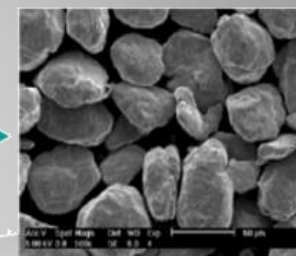
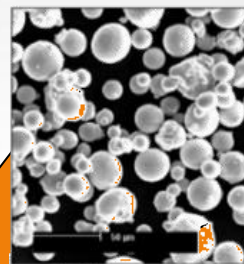


# Highlights

- Joining of Dissimilar Metals
- Powder Processing & Storage
- Applications
  - \*T-700 (MEO 1718)
  - \*Sump (Structural Repair)
- Alloy Development
  - \*5056
  - \*CrC-NiCr
- Additive Mfg.



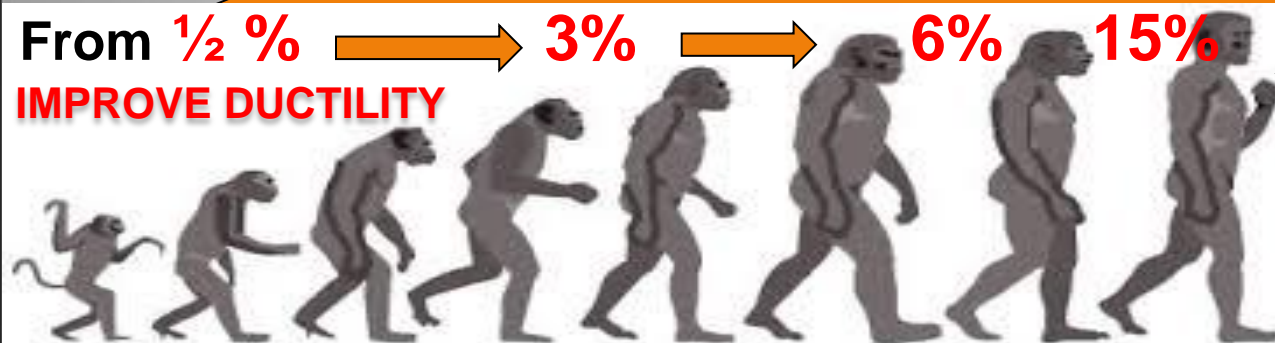
## MATERIALS BY DESIGN APPROACH



**Modeling & Simulation**  
**Powder Synthesis**

**Intelligent Processing & Controls**  
**Alloy Development/Optimization**

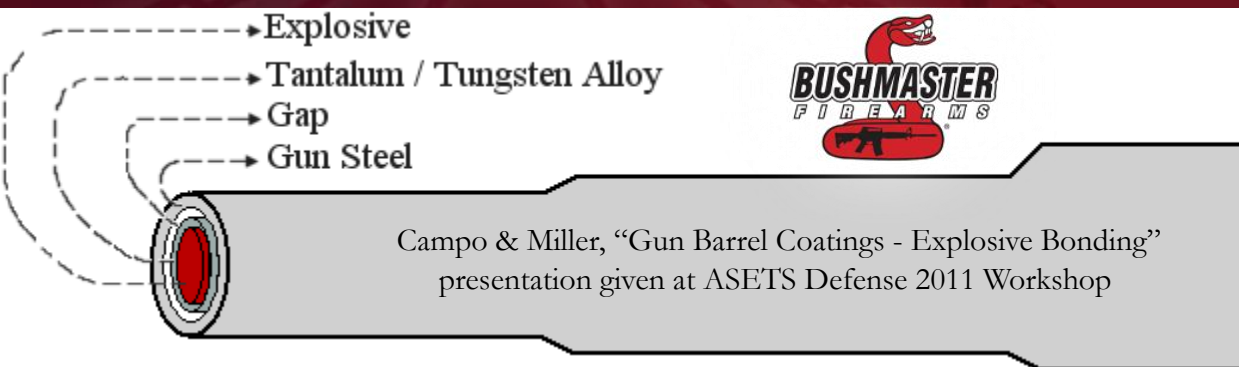
**Aerospace  
Aluminum**



**20%**



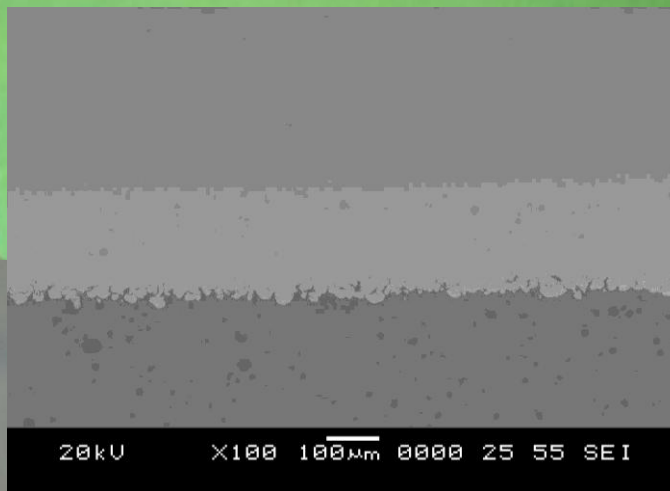
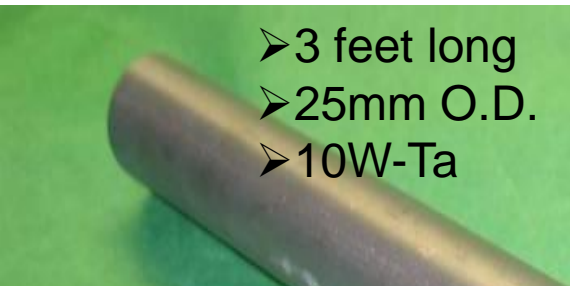
# Cold Spray Additive Manufacturing for Gun Barrels 10W-Ta Liners



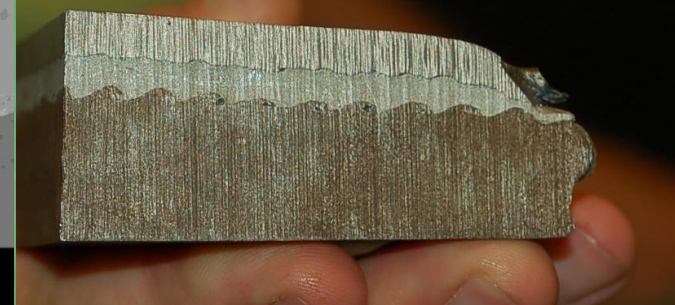
[www.metalwebnews.com](http://www.metalwebnews.com)



**Fig. 1 Explosive Welding**



[sections.aws.org](http://sections.aws.org)





# Cold Spray Research From Concept **ARL** to Transition (7 years-2005-2012)

**2012**

Industry

**TRL 9**

AF RIF

**TRL 8**

OSD & Army  
Mantech

AMRDEC

**TRL 7**

Flexible Robot Environment

NAVAIR

**TRL 6**

Reactive Materials Shaped Charge Liners

Powder 10,000lbs/month

FEB Panels & Hydro Tube

AFRL

**TRL 5**

**CHARACTERIZATION & TESTING** > UTS than Wrought **CONSOLIDATION**

TIPS

**TRL 4**

DLA

TMR

**TRL 3**

SBIR

**TRL 2**

ARL CII

**TRL 1**

ONR

**2005**

Nano and High Strength Al

Multi-Particle Interaction

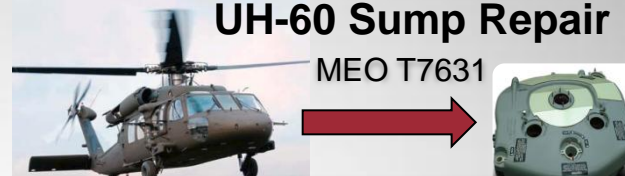
**PRODUCTION SCALE-UP**

**UH-60 Sump Repair**

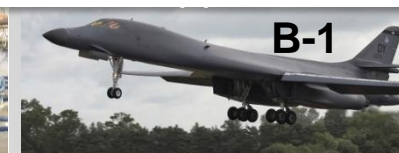
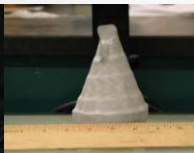
MEO T7631



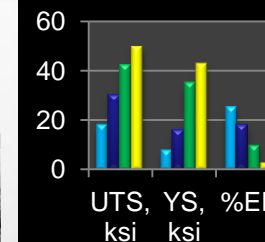
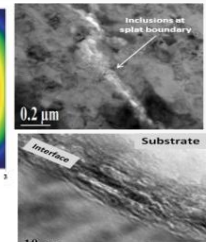
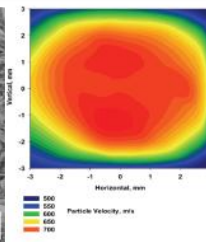
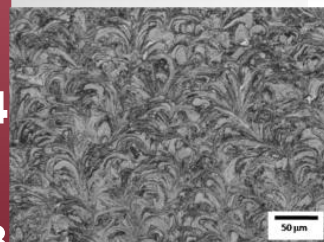
TD-63 Actuator



**First Approved Army-Navy & Air Force Applications**



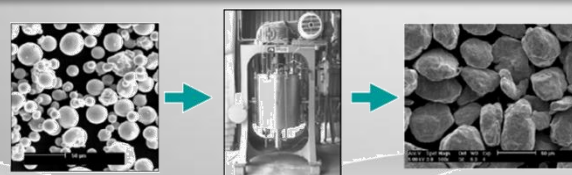
B-1



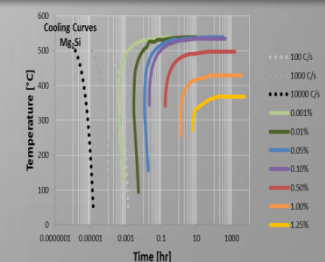
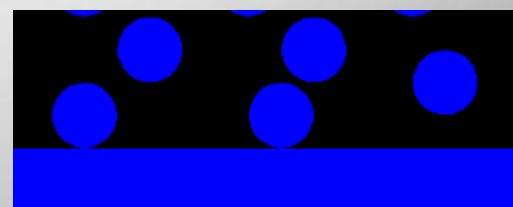
annealed  
T4-T451  
T6-T651  
cold sprayed



**POWDER SYNTHESIS**



**MODELING & SIMULATION**



# Fielded Applications of Cold Spray

Fielded SH-60 Seahawk with Cold Spray Mg Repair  
Operating Since August, **2009**-Australian Navy  
ARL/JSF/DSTO Collaboration



TD 63 Actuator  
In operation **2014**

Three Fielded Blackhawk Medvac Units with Cold Spray Al  
Repair Operating Since August, **2009**  
RL/AMCOM/Ft. Hood Collaboration



Fielded B-1 Bomber with Cold Spray Ti and Al Repair  
Operating Since September **2009**- Tinker AFB  
ARL/Tinker&Ellsworth AFB/HF Webster/SDSM  
Collaboration



FEB Panel

Two Expeditionary Fighting Vehicles with CS Mg Repair  
Fielded and Operating Since September, **2008**  
ARL/Allison Transmissions Collaboration



- Power Transfer Module - PTM
  - 10 Magnesium Castings
- Transmission
  - 13 Magnesium Castings



## Chafing - Aircraft Skin Panels & Hydro Tubes

Chafing Wear on Operational Panel

Main Landing Gear Line

Chafing Point  
Wear Tested

8 panels per aircraft  
Four panels per side  
Lt and Rt sides

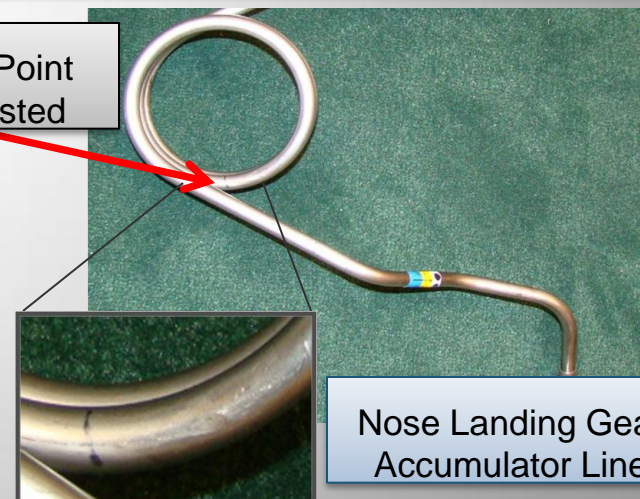
CS Applied Jan 2011 (2 A/C)  
~3 Years 4151 Combined Flt Hrs

Chafing Point  
Wear Tested

Nose Landing Gear  
Accumulator Line

CS Repaired June 2012  
3+ Years, 155 Flight Hours

CS Applied Mar 2009  
4+ Years, 2202 Flight Hours



# Vision for the Future

**Structural Repair &  
Additive  
Manufacturing**

- **Nuclear Power**
- **Munitions**
- **Electronics**
- **Medical**

**"Storage, Analysis,  
Failure Evaluation  
and Reclamation"  
(SAFR) at CCAD**

**Portable  
Applications**  
▪ **Petro-chemical**

**Don't Oversell**

**Air Force &  
NAVSEA  
Global  
Approval**

