The Cold Spray Revolution

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Introduction

• Cold spray is a method used to apply a metal coating or deposit, starting from metal powders.

• It is similar to metal thermal sprays but does not melt powder particles and does not affect substrates.

• Cold spray was first performed in the 1980s by a group of scientists at the Institute of Theoretical and Applied Mechanics of the Siberian Branch of the Russian Academy of Sciences.

• Since then cold spray has been commercialized and has been used for scores of applications.
The Basic Process
Process Physics

CFD

isentropic
Particle Velocities Needed for Deposition
An Example Cold Spray System

- Fume Hood
- Spray Nozzle
- Robot Arm
- Gas Heater
- Powder Feeder
Complete Cold Spray System with Machining and Helium Recovery
## Commercial Systems

<table>
<thead>
<tr>
<th>System Name</th>
<th>Max Pressure</th>
<th>Max Temp</th>
<th>InN₂</th>
<th>InHe</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRC Metal Systems</td>
<td>60 bar</td>
<td>750 °C</td>
<td>300g/min</td>
<td>120g/min</td>
</tr>
</tbody>
</table>
Aluminum Repair by Hand-Held Gun
From Powder to Consolidated Solid

6061 aluminum

tantalum
Coated Particles Deposition

20% copper
80% tungsten

70% nickel
30% aluminum
Repair of Damaged Parts
Sealing EM Leakage on Enclosure Panels

Comparison of Wear Resistance of Hard Coatings

![Graph showing comparison of wear resistance of different hard coatings.](image)

- **Cr plating**: Conventional hard surface
- **Stellite 21**: Cold sprayed surface
- **BAM alloy**: Cold sprayed surface
- **WC-Co**: Cold sprayed surface
- **WC-Co-Ni**: Cold sprayed surface
- **CrC-Ni**: Cold sprayed surface
Sterilization by Cold Sprayed Copper


Additive Manufactured Parts by Cold Spray

- Projectile rotating band
- Shaped charge liner
- Aluminum-nickel canister
- Bracket
Corrosion Protection of Magnesium

Bare ZE-41A magnesium

72 hours salt spray exposure

0.35 mm cold sprayed aluminum over magnesium

820 hours salt spray exposure
Cold Spray Repairs in Use

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

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

Fielded B-1 Bomber with Cold Spray Ti Repair Operating Since September 2009- Tinker AFB ARL/Tinker AFB/HF Webster Collaboration

Two Expeditionary Fighting Vehicles with Cold Spray Mg Repair Fielded and Operating Since September, 2008

- Power Transfer Module - PTM
  - 10 Magnesium Castings
- Transmission
  - 13 Magnesium Castings
Contact and Thank You

• The ARL Cold Spray web page is at:
• https://www.arl.army.mil/www/default.cfm?page=369
• (or you can just Google “ARL cold spray”)
• On it you can find more information and contact directions.