

# Cold Spray Technology from TWI



## What is Cold Spray?

Cold spray, or more precisely Cold Gas Dynamic Spraying (CGDS), is an exciting new coating technology for the production of high quality metal-based coatings. The process involves the deposition of metallic layers and structures from fine powders propelled using a high pressure gas jet.

The cold spray process provides a solution for applications where conventional metal spraying processes (e.g. flame, arc, plasma and HVOF spraying) are unsuitable, in which problems such as coating porosity, oxidation and low adhesion may occur.

Cold spray provides a wide range of technical benefits including:

- High strength coatings resulting from excellent inter-particle cohesion and adhesion to the substrate
- High quality coatings characterised by very low porosity and oxide, resulting in such properties as:
  - superior corrosion and oxidation resistance
  - lower coefficient of friction
  - high thermal and electrical conductivity

## How does cold spray work?

The powders used in the cold spray process typically range from 10µm to 50µm. These are accelerated to velocities between 500-1000ms<sup>-1</sup> in a supersonic jet of compressed gas.

Upon impact with the target surface, the solid particles experience plastic deformation that disrupts thin surface films (such as metal oxides), thus providing intimate conformal contact between clean metal surfaces under high local pressure. This permits bonding to occur, and layers of deposited material can be built up rapidly.

## TWI facilities

TWI has invested in a state-of-the-art commercial cold spray system. The CGT GmbH Kinetiks® 4000/47 system has been installed at TWI's Yorkshire Technology Centre. The equipment includes fully programmable integrated gas and powder heating units. The Active Jet Cold Spray Gun is mounted on a 6-axis robot, giving the system remarkable flexibility. The equipment is housed in a purpose-built booth with an integral extraction system.

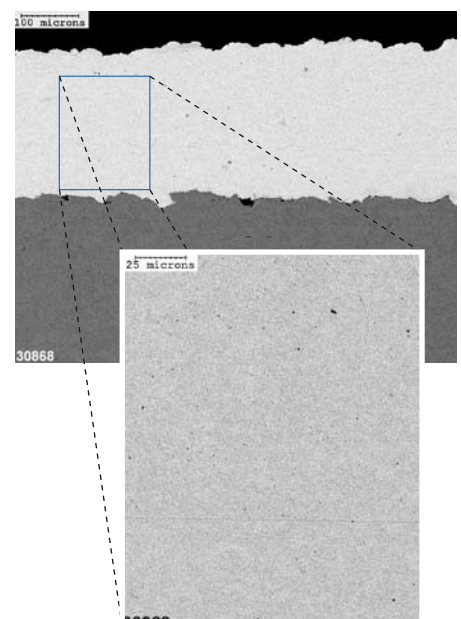
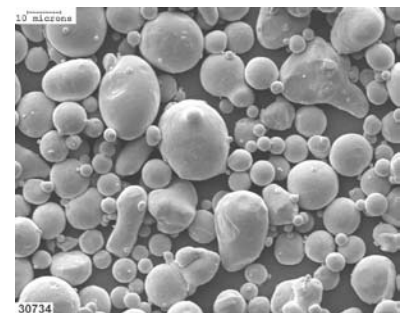
A number of materials have already proven to be suitable for deposition by cold spray. These include:

- Metals (Al, Cu, Ni, Ti, Ag, Zn, Ta, Nb)
- Refractory metals (Zr, W, Ta)
- Alloys (steels, Ni alloys, MCrAlYs)
- Composites (Cu-W, Al-SiC, Al-Al<sub>2</sub>O<sub>3</sub>)

With these materials in mind, a wide range of applications can be explored, with end uses in many industry sectors, as indicated in the table overleaf.



TWI's state-of-the-art cold spray system



Copper powder with particle size 5-30µm deposited using the cold spray technique in two 50µm layers to give a coating free of oxide and porosity.

Application	Coating material	Industry sector
<ul style="list-style-type: none"> <li>• Cd-plating alternative</li> <li>• Corrosion mitigation</li> <li>• Controlled potential coatings</li> </ul>	<ul style="list-style-type: none"> <li>• Al alloys</li> </ul>	<ul style="list-style-type: none"> <li>• Aerospace</li> <li>• Oil &amp; gas</li> <li>• Petrochemical</li> </ul>
<ul style="list-style-type: none"> <li>• Pb-free bearings e.g. con-rods, turbochargers</li> </ul>	<ul style="list-style-type: none"> <li>• Al, Cu alloys</li> </ul>	<ul style="list-style-type: none"> <li>• Automotive</li> <li>• Motorsport</li> <li>• Aerospace</li> </ul>
<ul style="list-style-type: none"> <li>• Thermal management e.g. power hybrid devices, switchgear</li> <li>• Conductive tracks</li> </ul>	<ul style="list-style-type: none"> <li>• Cu,Al, Cu-W</li> </ul>	<ul style="list-style-type: none"> <li>• Electronic</li> <li>• Automotive</li> </ul>
<ul style="list-style-type: none"> <li>• Corrosion mitigation</li> </ul>	<ul style="list-style-type: none"> <li>• Ti, Ta, Nb, NiCrFeMo</li> </ul>	<ul style="list-style-type: none"> <li>• Oil &amp; gas</li> <li>• Petrochemical</li> <li>• Power generation</li> </ul>
<ul style="list-style-type: none"> <li>• High temperature corrosion and oxidation mitigation e.g. gas turbines</li> </ul>	<ul style="list-style-type: none"> <li>• Ni alloys, MCrAlYs</li> </ul>	<ul style="list-style-type: none"> <li>• Aerospace</li> <li>• Power generation</li> </ul>
<ul style="list-style-type: none"> <li>• Biocompatible coatings for medical devices</li> </ul>	<ul style="list-style-type: none"> <li>• Ti</li> </ul>	<ul style="list-style-type: none"> <li>• Medical</li> </ul>

### TWI track record

TWI has been active in the area of thermal spraying for many years and operates high velocity oxyfuel spraying, arc spraying and flame spraying systems, and now cold spray.

Research activities are based on process development and investigation of new materials. Results of this work are then transferred to commercial applications.

The spraying facilities are run by a team of experts with many years of experience in relevant technologies. The team brings together knowledge and abilities from the

fields of surface engineering, metallurgy, corrosion, automation, mechanical engineering and chemical engineering.

The team comprises:

- Tiziana Marrocco - Cold spray programme co-ordinator
- David Marks - Materials engineering
- Peter Brown - Process automation
- Dave Harvey - Business support
- Phil Carroll - Powder deposition processes
- Melissa Riley - Thermal spraying
- Lee Smith - Analysis and testing
- Phil Buck - Technical support
- Andrew Tabecki - Technical support

### Contact us

For more information on TWI's cold spray services and facilities, contact Tiziana Marrocco:

TWI Technology Centre (Yorkshire)  
Wallis Way  
Catcliffe  
Rotherham  
S60 5TZ

Tel: +44 (0)114 269 9046  
e-mail: [tiziana.marrocco@twi.co.uk](mailto:tiziana.marrocco@twi.co.uk)

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