

1. Record Nr.	UNINA9910485599703321
Titolo	Practical cold spray // Victor Kenneth Champagne Jr., Ozan Cagatay Ozdemir, Aaron Nardi, editors
Pubbl/distr/stampa	Cham, Switzerland : , : Springer, , [2021] ©2021
ISBN	3-030-70056-9
Descrizione fisica	1 online resource (445 pages)
Disciplina	660.283
Soggetti	Metal spraying
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Intro -- Preface -- Contents -- 1 Introduction -- 1.1 Process Description -- 1.2 Comparison to Thermal Spray -- 1.3 Advantages and Limitations -- 1.3.1 Strength -- 1.3.2 Hardness -- 1.3.3 Variety of Feedstock Powders -- 1.3.4 Cost -- 1.3.5 Ease of Production and Portability -- 1.3.6 Additive Manufacturing -- 1.4 Summary of Advantages and Limitations -- 1.4.1 Advantages -- 1.4.2 Limitations -- References -- 2 Process Description -- 2.1 Introduction -- 2.2 Cold Spray Process -- 2.3 System Classification -- 2.3.1 Classifying Cold Spray Systems According to the Mode of Operation -- 2.3.2 Classifying Cold Spray Systems According to Powder Feeding and Acceleration Mechanism -- 2.4 Supersonic and Sonic Nozzle Description -- 2.5 Cold Spray Powders -- 2.6 The Deposition Process -- 2.7 Powder and Substrate Hardness -- 2.8 Deposition Efficiency -- 2.9 Deposition Path -- 2.10 Nozzle Materials -- 2.11 Fundamentals of Cold Spray Process -- 2.11.1 Gas Flow in Cold Spray -- 2.12 Particle Flow Behavior -- 2.12.1 Particle Velocity -- 2.12.2 Particle Heat Transfer -- 2.13 Bonding Mechanism -- References -- 3 Setting Up a Cold Spray Facility -- 3.1 Introduction -- 3.2 Cold Spray Unit -- 3.3 Gas Supply -- 3.3.1 Nitrogen -- 3.3.2 Helium -- 3.4 Powder and Gas Control -- 3.5 Ventilation and Dust Control -- 3.6 Acoustic Enclosure -- 3.7 Robotic Motion Control -- 3.8 Equipment Placement -- 3.9 Safety -- 3.9.1 Environmental Safety -- 3.9.2 Solid Powders -- 3.9.3 Inert Gases -- 3.9.4 High Pressure Gases -- 3.9.5 Hearing Hazards --

3.9.6 Hot Surfaces -- 3.9.7 Flying Objects -- 3.9.8 Robot Safety --
3.9.9 Maintenance of Safety Systems and PPE -- 3.9.10 Fire/Explosion
Safety -- 3.10 Auxiliary Equipment -- 3.11 Summary of Equipment --
References -- 4 Feedstock Powders -- 4.1 Significance of Powder
Microstructure in Cold Spray.
4.2 Correlation Between Powder and Deposit Microstructures -- 4.2.1
Microstructural Phases in Powders and Deposits -- 4.2.2 Grain Size
in Powder and Deposits -- 4.2.3 Relationship of Deformation
with Inter-Particle Bonding -- 4.3 Introduction to Powder Basics --
4.3.1 Size Distribution -- 4.3.2 Powder Flowability -- 4.3.3 Morphology
-- 4.3.4 Hardness -- 4.3.5 Adsorbed Moisture (Flow and Degas During
AM) -- 4.4 Desirable Powder Characteristics -- 4.4.1 Surface (Oxides,
Hydroxides) -- 4.4.2 Interior (Homogenization, Phase Transformations)
-- 4.5 Processing Required to Achieve Desirable Powder -- 4.5.1 Heat
Treatment -- 4.5.2 Size Classification -- 4.6 Multi-phase Powders --
4.7 Concluding Remarks -- References -- 5 Material Properties -- 5.1
Aluminum -- 5.1.1 Aluminum Properties -- 5.2 Brass and Bronze --
5.3 Copper -- 5.3.1 Copper Properties -- 5.3.2 Alloys of Copper --
5.3.3 Cold Spray Copper -- 5.4 Titanium -- 5.4.1 Titanium -- 5.4.2
Uses -- 5.4.3 Cold Spray Titanium -- 5.5 Stainless Steel -- 5.5.1
Stainless Steel Uses -- 5.5.2 Cold Spray Stainless Steel -- 5.6 Nickel --
5.6.1 Nickel Properties and Common Use -- 5.6.2 Cold Spray Nickel --
5.7 Tantalum -- 5.7.1 Tantalum Properties and Common Use -- 5.7.2
Cold Spray of Tantalum -- 5.8 Alloys for Replacing Chrome and Nickel
Electroplating -- 5.8.1 Electroplated Cr and Ni Replacement Powders --
5.9 Inconel -- 5.10 Polymers and Composites -- References -- 6
Application, Qualification, and Standardization of Cold Spray -- 6.1
Introduction -- 6.2 Identification of Applicable Standards, Governing
Bodies, and Approval Authorities -- 6.3 Standards and Guidelines
Applicable to Cold Spray -- 6.3.1 Powder Specification Standards --
6.3.2 Applicable Cold Spray Standards -- 6.3.3 Applicable Thermal
Spray Standards -- 6.4 Writing New Standards -- 6.4.1 Having
a Controlled and Bounded Process.
6.4.2 Acceptable Versus Unacceptable Variation -- 6.4.3 Evaluating
Process Variation Versus Property Variation -- 6.4.4 Testing -- 6.4.5
Obtaining Stakeholder Involvement -- 6.4.6 Funding the Qualification
Effort -- 6.5 Quality Testing -- 6.5.1 Impact Testing -- 6.5.2
Microscopic Examination -- 6.5.3 Adhesion Tensile Bond Strength --
6.5.4 ARL 'Glueless' Bond Strength Test -- 6.5.5 Triple Lug Shear
Adhesion -- 6.5.6 Tensile Testing -- 6.5.7 Fretting Fatigue -- 6.5.8
Corrosion Testing -- 6.6 Nondestructive Evaluation of Cold Spray
Deposited Products -- 6.6.1 Ultrasonic Testing -- 6.6.2 Acoustic
Emissions Testing -- 6.6.3 Eddy Current Testing -- 6.6.4 Dye
Penetrant Testing -- 6.6.5 Magnetic Particle Testing -- 6.6.6
Radioscopy -- 6.6.7 Visual-Optical -- 6.7 Troubleshooting -- 6.7.1
Cold Spray Process Related Problems -- 6.7.2 Leaks, Clogs, and Nozzle
Wear -- 6.7.3 Component Failures -- 6.8 Example of Cold Spray
Procedure Qualification -- 6.8.1 Project Structure -- 6.8.2
Development of a Joint Test Protocol (JTP) -- 6.9 Summary --
References -- 7 Process Control -- 7.1 Introduction -- 7.2 Surface
Preparation -- 7.3 Basic Parameters -- 7.3.1 Gas Conditions -- 7.3.2
Particle Velocity and Temperature Determination -- 7.3.3 The Critical
Velocity -- 7.3.4 Gas and Powder Flow Rates -- 7.4 Application Setup
-- 7.5 In Situ Process Analysis -- 7.5.1 In Situ Particle Velocity
Measurement -- 7.5.2 In Situ Coating Property Sensing -- 7.6 Summary
-- References -- 8 Cold Spray Economics -- 8.1 Introduction -- 8.2
Basic Framework -- 8.3 Powders -- 8.4 Gas -- 8.5 Powder Mass
Loading -- 8.6 Direct Labor Costs -- 8.7 Overhead -- 8.8 Depreciation

and Capital Recovery -- 8.9 Examples of Cost Calculations -- 8.10 Effects of Process Variables -- 8.10.1 Gas -- 8.10.2 Powder Feed -- 8.10.3 Powder Cost -- 8.10.4 Deposition Efficiency -- 8.10.5 Utilization.

8.10.6 Number of Pieces to Be Produced -- 8.11 Determination of Operating Parameters -- 8.12 Production Capacity -- 8.13 Important Factors in Determining the Viability of a Cold Spray Repair -- 8.14 Concluding Thoughts -- References -- 9 Advancements in Cold Spray -- 9.1 Introduction -- 9.2 Intelligent Process Control -- 9.2.1 Machine Learning -- 9.2.2 High Rate Cold Spray Manufacturing -- 9.2.3 Laser-Assisted Cold Spray -- 9.3 Advanced Cold Spray Materials -- 9.3.1 Aluminum and Aluminum Alloys -- 9.3.2 Chrome Plating Replacement -- 9.3.3 Composite Materials -- 9.3.4 Polymer Applications -- 9.4 Joining of Dissimilar Materials -- 9.4.1 Importance of Magnesium -- 9.4.2 Practicality and Advantages of Cold Spray -- 9.4.3 Joining of Aluminum to Magnesium -- 9.4.4 Applications of Joining Aluminum to Magnesium -- 9.4.5 Testing Joint Integrity -- 9.4.6 Discussion -- 9.5 3D Additive Manufacturing -- 9.5.1 Conforming Material onto a Substrate -- 9.5.2 Additive and Subtractive Manufacturing -- 9.5.3 Freeform Manufacturing -- 9.5.4 Challenges in Cold Spray 3D Additive Manufacturing -- 9.6 Cold Spray System Developments Driven by Application -- 9.6.1 Capillary Cold Spray -- 9.6.2 Nozzle Design -- 9.6.3 On-Demand Field Repair and Portability -- 9.7 Advanced Cold Spray Facilities -- 9.7.1 Multi-Axis and Multi-Process Integrated Repair and Manufacturing Cell Concept -- 9.7.2 Cold Spray Repair and Rebuild Technology Cell (CSRRT Cell) -- 9.7.3 Hybrid Cold Spray Manufacturing and Repair Cell -- 9.7.4 Helium Automated Repair and Recovery and Repair Manufacturing System (CS-HARRPS) -- References -- 10 Applications -- 10.1 Introduction -- 10.2 Aerospace -- 10.2.1 Repair of Magnesium Aircraft Parts -- 10.2.2 Miscellaneous Aerospace Applications -- 10.2.3 Repair of B1 Bomber Forward Equipment Bay (FEB) Panels -- 10.2.4 B1 Bomber Hydraulic Lines. 10.2.5 AH-64 Static Mast Support -- 10.2.6 Residual Stress -- 10.2.7 T-700 Engine Front Frame -- 10.2.8 Landing Gear -- 10.3 Naval -- 10.3.1 Pump Housing -- 10.3.2 Flo-Tork Actuator -- 10.3.3 Cone Assembly -- 10.3.4 Periscope -- 10.4 Automotive -- 10.4.1 Insulated Gate Bipolar Transistor (IGBT) Baseplates -- 10.4.2 Selective Galvanizing and Corrosion Protection of Trim -- 10.4.3 Engine Block Repair -- 10.5 Electronics -- 10.5.1 Electromagnetic Shielding -- 10.5.2 Thermal Management -- 10.6 Medical -- 10.6.1 Antimicrobial Coatings -- 10.7 Additive Manufactured Cold Spray Parts -- References.
