SOLVUSGLOBAL

Machine Learning & Advanced Powder Developments

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Major Highlights for Cold Spray Powders



SAAM 7075, 2024, 6061, 7050 WIP C1, BC1, C2

NON-FLAMMABLE NON-COMBUSTIBLE



Integrated, Engineered, NFPA Compliant Powder Handling & Storage





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Importance of Product Insight

Impact of Powder Size on Spray Performance



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Practical Significance	System Clogging
Quantitative Metric	Size Distribution

- ISO 13322 Method
- Powder is settled in media to electrostatically disperse particles
- Images of powder outlines are taken using a microscope (at 20X)
- Particle size distribution is calculated using measured radii, in terms of volume % and number %
- Circularity captures particle aspect ratio and morphology

Cooke, April, and John Slotwinski. *Properties of metal powders for additive manufacturing: a review of the state of the art of metal powder property testing*. US Department of Commerce, National Institute of Standards and Technology, 2012.

ISO 13322-1: 2004 (E), Particle Size Analysis, Image Analysis Methods. Static Image Analysis Methods





Standard backlighting image



Practical Significance	Contamination
Quantitative Metric	% Compaction

- Constant volume of powder is compacted under constant, rapid impact force
- Measures ability of powder to compact into a puck during impact, and strength of puck after impaction





Left: SEM cross section of impacted sample

Above: side view of impacted sample

Percent Mass Compaction for Variety of Materials

Aluminum Tantalum WIP Titanium Iron Copper





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Upcoming Materials in 2020

4340 Alloy Steel



WIP-W1 (WC-Ni)



Cu-W



Signal A = SE1 Reference Mag = Polaroid 545

Nitinol



High Purity Copper



CP Titanium



FeCrAly



Bronze



Augmented Process Ecosystem – Cold Spray



Data Isolation:

- Datasets split into 60/20/20 fraction
- Prevents model from overfitting the dataset

Hybrid Modeling:

- Pre training done with physical modeling
- Secondary training done with velocimetry data

Generation

Data



System Parameters:

- Nitrogen Carrier Gas
- AL 2024 powder
- VRC Nozzle 71
- Measured at Nozzle Exit

Average Prediction Accuracy:

• Within half a measured STD



650

Pressure (psi)

700

750

800

500

450

500

550

600



Leveraging:

- Particle size
 distribution
- Material data
- Nozzle condition
- Carrier gas



Augmented Process Ecosystem – Cold Spray





Sample	T (°C)	P (psi)	Mass Deposited (lbs)	Percent Deposited (%)
AI	468	713	0.125	62.5
+-10%	384	819	0.12	60.0
-10%	384	606	0.1	50.0







Model Execution time Simulating 1000 particles

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