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Abstract

The Impact of Post Processing Heat Treatments on Elemental Distribution and Corrosion Properties of Cold Spray Printed Al Alloys †

Ruby Alice Sims [1,*,‡], Rebecca Adamson [2,§], Rebecca Murray [3,‖] and Jamie Scott Quinton [1,¶]

[1] Flinders Institute for Nanoscale Science and Technology, Flinders University Flinders Microscopy and Microanalysis (FMMA), Flinders University, Bedford Park, SA 5042, Australia; jamie.quinton@flinders.edu.au
[2] Advanced Manufacturing Alliance, Charles Darwin University, Casuarina, NT 0810, Australia; becky.adamson@uwa.edu.au
[3] David Geffen School of Medicine, University of California, Los Angeles, CA 90024, USA; Becca.Murray@health.qld.gov.au
* Correspondence: rasims@mednet.ucla.edu
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‡ Current address: David Geffen School of Medicine, University of California, Los Angeles, CA 90024, USA.
§ Current address: School of Engineering, Chemical Engineering, The University of Western Australia (M050), 35 Stirling Highway, Perth, WA 6009, Australia.
‖ Current address: Herston Biofabrication Institute, Metro North Health, Brisbane, QLD 4029, Australia.
¶ Current address: School of Natural Sciences, Massey University, Palmerston North 4442, New Zealand.

Abstract: In contrast to other additive manufacturing methods such as Wire Arc Additive Manufacturing or Laser Metal Deposition, the cold spray system designed by SPEE3D allows for structures to be printed at much lower temperatures. As a result, structures printed via cold spray often undergo post processing heat treatments that potentially alter the distribution of trace elements throughout the sample. The distribution of elements within these structures may then have a direct impact on the corrosion properties of these materials. The impact of post processing heat treatment parameters on the microstructure and distribution of Mg and Si trace elements within an Al alloy was investigated using cross section analysis of samples by SEM-EDS. From an Al-powered feedstock, alloys were printed using SPEED3D's LightSPEE3D printer utilising air as the carrier gas, at 30 Bar and 500 °C; various post processing heat and water quench treatments were then applied. The results revealed a reorganisation of Mg (which subsequently becomes oxidised) toward the edges of pores, regions that typically have a higher surface energy. This is in direct contrast to the largely homogenous distribution of Mg in the samples that did not undergo post printing heat treatments. The addition of charcoal during the heat treatment process also resulted in the redistribution of Si within the sample, and the creation of silicon carbide structures. The impact of the reorganisation of Mg within the sample as well as the creation of silicon carbide structures on the selective corrosion of these materials was then investigated using potentiodynamic corrosion testing and electrochemical impedance spectroscopy.

Keywords: cold spray; aluminium alloys; corrosion; LightSPEE3D; electrochemical impedance spectroscopy; SEM-EDS; corrosion; 3D-printed metals

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