# Microstructure and Multi-scale Mechanical Properties of Cold Sprayed Scalmalloy-Al7075 Composite Deposits

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Limited strength of cold-sprayed commercially available Aluminum alloys for load-bearing applications can be mitigated by tailoring feedstock composition. In this study, a mixture of Scalmalloy-7075 (1:1 by wt.) powders was employed to manufacture cold-sprayed deposits using helium (He-deposit) and nitrogen (N2-deposit) as the carrier gas in a high-pressure cold spray system. Microstructural analysis showed enhanced splat flattening and lower porosity in the He-deposit than N2-deposit, indicating severe plastic deformation. Owing to increased deformation, indentation within a single splat revealed 20% higher nanohardness in He-deposit than in N2-deposit. As the measurement-scale length progressed, larger microstructural features, such as pores and inter-splat bonding became evident, as demonstrated by 149 HV microhardness in He-deposit, 12% higher than N2-deposit (133 HV). Furthermore, at a bulk level, Profilometry-based indentation plastometry (PIP) revealed higher yield stress (σY), 400 ± 17 MPa and ultimate tensile strength (UTS), 528 ± 13 MPa for He-deposit, as compared to N2-deposit (σY = 311 ± 6 MPa; UTS = 476 ± 6 MPa). The enhanced hardness and strength suggest the potential of tailored composition using composite feedstock to develop cold-sprayed Al alloy with strength surpassing state-of-the-art Al7075.