Assessing Feasibility of Nanoporous Copper Powders and Hybrid Feedstocks with Copper Nanoparticles for Laser Powder Bed Fusion

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The integration of Nano-porous metals (NPMs) into Additive Manufacturing (AM) has garnered significant attention due to their capability to construct intricate three-dimensional structures with nanoscale features in a high-throughput manner, allowing to exploit the inherent size-dependent properties of the NPMs, such as their high surface area and conductivity[1], especially in the areas of energy storage and biomedicine [2,3]. One approach for the integration of NPMs into AM is to use nano porous powder as feedstock for Laser Powder Bed Fusion (LPBF) as nano-porous copper (np-Cu) powders, for instance, present reduced reflectivity measured as 36% lower than its solid counterpart[4], and thus a great potential to significantly reduce energy requirements during printing. Additionally, they exhibit a considerably lower sintering temperature, equivalent to only 46% of solid copper's melting temperature[5]. This work exploits the potential application of this innovative strategy through analyzing flowability, spreadability, and homogeneity of chemically dealloyed np-Cu powders and hybrid feedstocks including Cu nanoparticles (np-Cu/Cu NPs), to ensure homogeneous powder layer deposition during printing. Initial findings from single-layer powder beds ($90x90x0.05mm^3$) deposited through Doctor Blade coating method confirmed that spreadability is adversely affected by humidity[6] and revealed nanoparticle content dependence. Upcoming investigations comprehend additional spreadability analysis for different layer heights, as well as homogeneity investigation of feedstocks with varied np-Cu:Cu NPs ratios by optical micrographs and Hall flowability measurements.

[1] Materials 2020, 13(17), 3706
[2] MRS Bulletin 2018, 43(1), 43-48
[3] Nano Select 2021, 2(8), pp.1437-1458.
[4] MSEC 2023 (Vol. 87240, p. V002T08A005)
[5] Applied Materials Today, 32, 101802
[6] Prog Addit Manuf 2019, 4, 383–397