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Implementing an active strategy to the conservation and advancement of Laser Powder Bed Fusion (LPBF) powder feedstock

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Additive manufacturing (AM), particularly Laser Powder Bed Fusion (LPBF), is rapidly advancing due to its increasing adoption as an advanced manufacturing technique capable of producing intricate and reliably consistent parts. However, this heightened interest in AM has prompted concerns regarding its sustainability. In response, a recent study conducted a comprehensive experimental effort spanning several months, completing over 25 prints of a high-alloyed corrosion-grade stainless steel. The primary objective was to extend the lifespan of LPBF powder feedstock by salvaging powder that would otherwise be discarded and identifying the properties that render it unusable. Additionally, the study aimed to mitigate the detrimental effects of unusable powder by reapplying it into the LPBF print cycle and evaluating the resulting part quality. Moreover, alternative applications for powders deemed unsuitable for LPBF technology post-rejuvenation were explored. Throughout the printing window, various avenues for powder disposal were identified, including i) oversized powders collected post-sieving, ii) powders captured in the LPBF system's filtration system, and ii) powders contaminated with oxidation effects that have exceeded their reusable lifespan. These powders underwent extensive physical (such as powder size distribution, flowability, porosity, and morphology) assessment and chemical property analyses to identify deviations from virgin or reusable LPBF feedstock powders. Based on the identified deviations, rejuvenation methods such as milling of larger particles were applied, and the powders were reintroduced into the LPBF process. The results of these experiments contribute to improving the sustainability of LPBF technology and improve industry reliance on LPBF.

Speaker Country

Singapore

Primary authors: Dr CAGIRICI, Mehmet (Singapore Centre for 3D Printing, Nanyang Technological University, Singapore); ALAGESAN, Alpravinosh (Nanyang Technological University); Prof. BARTOLO, Paulo (Singapore Centre for 3D Printing, Nanyang Technological University, Singapore)

Presenter: Dr CAGIRICI, Mehmet (Singapore Centre for 3D Printing, Nanyang Technological University, Singapore)

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