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Metal Additive Manufacturing via Molten Metal Droplet Jetting

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Abstract

The potentially disruptive nature of additive manufacturing (AM) on industrial supply chains is well documented. For example, unitized part assemblies reduce assembly costs and the number of suppliers that manufacturers require. On-demand manufacturing eliminates the cost of warehouse inventories and product obsolescence. The cost of molds and dies and machine changeovers is also eliminated. Despite these advantages, the throughput of AM is much lower than traditional processes, and per-part manufacturing costs are typically much higher than conventional processes. AM of production parts has therefore been largely limited to aerospace and biomedical applications. This talk will describe an emerging AM process that has the potential to expand AM's adoption into a wider range of mainstream applications. Specifically, Molten Metal Droplet Jetting (MMJ) is an AM process that jets droplets of molten metal towards a moving substrate to produce 3D metal components. This talk will present the basics of the MMJ process, the fluid dynamics describing jetting of molten metal droplets and their coalescence after impact, and the exciting development of multi-nozzle MMJ. Multi-nozzle jetting at high frequencies (i.e. hundreds to thousands of drops per second) can achieve extremely high material deposition rates while preserving fine feature resolutions. The process also eliminates the use of metal powders and lasers, thus greatly reducing material and equipment costs.