**The role of the laser-induced recoil pressure on metal drops and its applications for Additive Manufacturing**

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Abstract:

Additive Manufacturing regroups numerous different techniques of whom some have reached very high development and are now used in the industry. Other techniques such as Micro Droplet Deposition Manufacture are under development and present different manufacturing possibilities, but only for low melting temperature metals. In this paper, the possibility of using a laser-based droplet deposition technique from a metal wire is investigated. This technique is expected to be a more energy efficient and a more flexible alternative to Laser Metal Wire Deposition. Laser Drop Generation experiments were carried out in order to detach accurately metal drops in the desired position. High‑speed imaging was used to observe the drop generation and measure the direction of detachment of the drops. The effects of a continuous power laser beam on the acceleration of metal drops was investigated. The recoil pressure was found to be the main driving effect, but other phenomena counteract this acceleration and reduce it by an

order of magnitude of one to two. In addition, two different vaporization regimes were observed, resulting respectively in a vapor plume and in a vapor halo around the drop. Two drop detachment techniques were investigated and the physical phenomena leading to the drop detachment were explained, where the drop weight, the surface tension and the recoil pressure play a major role. Optimized parameters for an accurate single drop detachment were identified and thereafter used to build multi-drop tracks. Tracks with an even geometry could be produced, where the microstructure is marked by the numerous drop depositions. The tracks showed a considerably higher hardness than the base wire, exhibiting a relatively homogeneous hardness with a possible localized softening effect at the interface between two drops.