Abstract for NANOMAN2024(500 words)
Effect of gaseous environment on powder particle spattering during laser powder bed fusion process

Liwei Chen[1,#], Yanling Song [1], Yoshiki Sakai [1] and Keisuke Nagato [1]

1 Department of Mechanical Engineering, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-8656, Japan
Corresponding Author / Email: chen@hnl.t.u-tokyo.ac.jp

KEYWORDS: Laser powder bed fusion, Plume, Molten pool, Particle sputtering

---

Laser Powder Bed Fusion (LPBF) is an advanced additive manufacturing technique, which uses a high-power laser to selectively melt and fuse metal powder particles to create complex geometries. However, the component quality is significantly affected by the spatter during the LPBF process. These spatters can significantly affect the quality and consistency of the final product by introducing defects and irregularities. The velocity, flow direction, and quantity of the sputtered powder particles are influenced not only by laser power and scan speed but also by the gaseous environments during the LPBF process. This research investigates the impact of various gaseous atmospheres, specifically argon, nitrogen, and oxygen, on the dynamics of powder spattering. It combines experimental observations with high-speed imaging and numerical simulations to analyze the trajectory, velocity, and distribution of ejected particles under different gas environments. The results indicate that the type of gas plays a crucial role in the spattering mechanism, with each gas influencing the molten pool dynamics and particle ejection in unique ways. For example, argon and nitrogen exhibited more controlled ejection patterns but caused larger melt pool perturbations due to their higher densities. It provides valuable insights for optimizing LPBF processes by selecting appropriate gaseous environments, thereby enhancing build quality and reducing defects. The study concludes that a tailored approach to gas selection can effectively mitigate spattering effects and improve the overall efficiency and reliability of LPBF additive manufacturing. By understanding and controlling the influence of different gases, it can achieve more consistent and higher-quality production outcomes in additive manufacturing.

Word count: Not more than 500 words