32ND RESEARCH SYMPOSIUM ASNT EVENTS.

Presented At: ASNT Research Symposium:
25 – 28 June 2024
Pittsburgh, Pennsylvania, USA

Eddy current testing of metal powder spread consistency in Laser Powder Bed Fusion (LPBF) Additive Manufacturing (AM) Process

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ABSTRACT

Additive manufacturing (AM) processing technology has advanced significantly in recent years. However, in-situ, real-time, and accurate evaluation of metal powder properties in the laser powder bed fusion (LPBF) is lagging. This is particularly the case when the local properties of metal powder as a function of C-scan mapping or event depths are of interest. Eddy current method is one of the crucial non-contact nondestructive testing methods that can penetrate several millimeters inside metals, and measure the inhomogeneity of the properties of metallic samples. This work focuses on an initiative investigation of the efficacy of eddy current to evaluate the "consistency" of metal powder in the laser LPBF AM process. Consistency refers to variation in powder size distribution, surface properties (i.e., roughness), and other undesired powder characteristics, such as volume distributions of metal powders. To interrogate the properties, both solder ball and metal powder 410L of different sizes are measured repetitively with a wide band frequency range sweeping from 50 kHz to 500 kHz. By leveraging an electromagnetic eddy current C-scan system, powder size is discriminated by the indication of sweep-frequency eddy current signals. To validate the eddy current C-scan mapping of metal powders, repetitive C-scan mappings are compared to investigate the measurement uncertainty. From the measurement results, repetitive measurements show a decent agreement, which means the Signal-to-noise ratio (SNR) is good and the eddy current C-scan mapping indicates a reliable mapping of property inhomogeneity.

Keywords: Eddy Current, Nondestructive Evaluation, Additive Manufacturing (AM), Laser Powder Bed Fusion (LPBF), Metal Powders