V International Conference on Simulation for Additive Manufacturing, SIM-AM 2025
September 9-11, 2025, Pavia, Italy

QUANTITATIVE OPTICAL PROCESS MONITORING IN METAL ADDITIVE MANUFACTURING

PHILIPP PETER BREESE* AND SIMON OSTER*

*Bundesanstalt für Materialforschung und -prüfung
Unter den Eichen 87, 12205 Berlin
philipp-peter.breese@bam.de // www.bam.de/thermography

ABSTRACT

Although metal additive manufacturing (MAM; metal 3D printing) processes have the potential to produce complex parts of high density, a lack of process knowledge still prevents further progress in product quality. A well-known example is the highly stochastical formation of defects such as porosity or cracks during printing. To advance the understanding of MAM, optical sensors can be used to acquire datasets in high spatiotemporal resolution representing the current process conditions.[1] These datasets also have a high value in the context of model validation of multi-physics simulations.[2] However, the measurement of quantitative properties such as temperatures, melt pool morphologies or spatter behavior is challenging. This is due to the high process dynamics (especially in powder bed fusion) and complex thermophysical interactions of the melt pool. Therefore, there is a need for approaches that can acquire quantitative measurands which monitor the local process conditions.

In this session, the focus lies upon works that study optical sensor-based methods for process monitoring of MAM. Within the scope are for example contributions that deal with process monitoring for quality assessment, defect detection, enhanced process understanding, and experimental validation of simulation models.

REFERENCES

[1] Taherkhani K., Ero O., Liravi F., Toorandaz S., Toyserkani E., *On the application of in-situ monitoring systems and machine learning algorithms for developing quality assurance platforms in laser powder bed fusion: A review*, Journal of Manufacturing Processes, Vol. 99, pp. 848-897, 2009.

[2] Bayat M., Dong W., Thorborg J., To A. C., Hattel J. H., *A review of multi-scale and multi-physics simulations of metal additive manufacturing processes with focus on modeling strategies*, Additive Manufacturing, Vol. 47, 2021.