Autumn 2023

Optics & Photonics Group Lunchtime Seminar Series

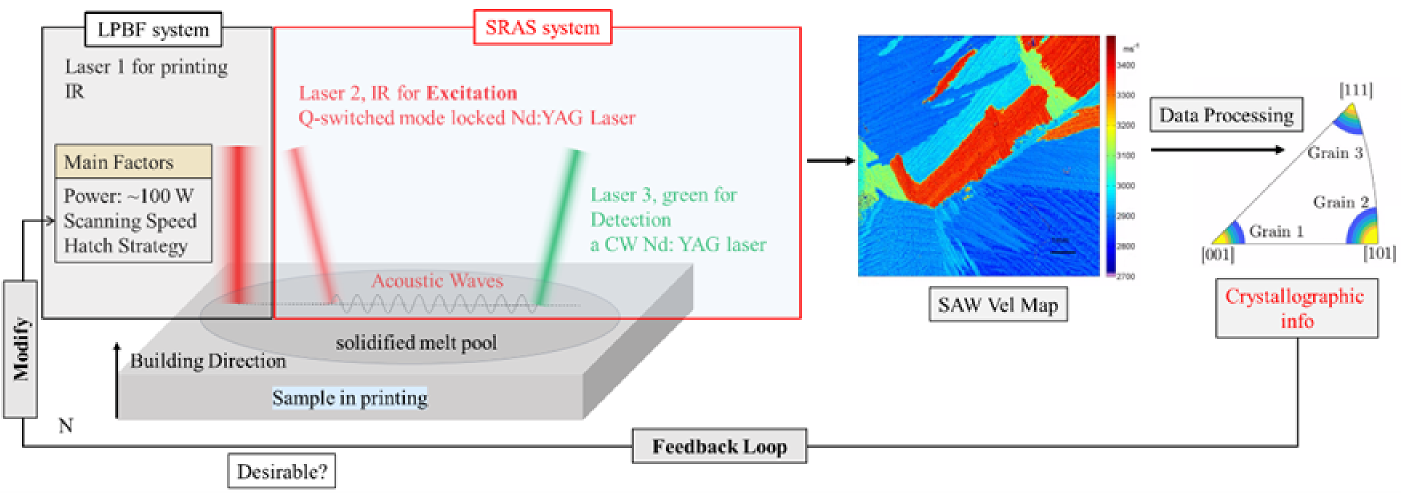
University of Nottingham

Control of LPBFed Microstructure via SRAS in a Real-time Capacity

Peng Jin

University of Nottingham

Detection of LPBFed Microstructure via SRAS in a Real-time Capacity



13:30 Wednesday 8 November 2023

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Peng Jin

Control of LPBFed Microstructure via SRAS in a Real-time Capacity

Materials used in performance engineering (e.g., metals and alloys) consist of crystals (or grains) and the size, orientation, and distribution of these crystals (microstructure) plays a significant role in determining the material characteristics, including mechanical responses and physical properties. The microstructure-dependent performance will finally decide the service performance of the safety-critical industrial application.

Additive manufacturing is a promising free-geometry deposition technology and has been widely used in industries including aerospace, automotive manufacturing, energy production and precision medicine. Include simple statement of the limitations with respect to the microstructure. However, due to complex thermal history of the manufacturing process, which drive the formation of microstructure, it is still challenging to print the parts with desirable microstructure. The lack of control on microstructure will result in big deviations in the performance of AM parts, even if the defects can be neglected.

This PhD will develop techniques to "print" the microstructure required for optimal performance on demand via real-time feedback from in-situ Spatially Resolved Acoustic Spectroscopy (SRAS) measurements. SRAS is based on laser ultrasound to generate and detect the surface acoustic waves (SAWs), then the wave velocities can be converted into the crystalline information on which they propagate, it can determine the elasticity, crystalline orientation, and the single crystal elasticity matrix of polycrystalline materials in a fast and easy measurement.

This project is to combine the SRAS into the chamber of a LPBF machine to achieve an in-situ design the local microstructure with the crystalline information feedback from the SRAS. To be more specific, the SRAS will give the crystalline information of the solidified melt pool, and judge whether the crystals are desirable, if not, the main parameters in LPBF machine should be modified. Before an in-situ capacity, some preliminary experiments should be conducted to figure out how the main process parameters influence the microstructure enabling future control of grain growth once in-situ measurements are possible.

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All are welcome

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