Advancing Spatially Resolved Acoustic Spectroscopy (SRAS) from Microstructure to Elasticity Imaging

Rikesh Patel[1], Wenqi Li[2], Paul Dryburgh[3], Rafael Fuentes-Dominguez[2], Richard Smith[2], Matt Clark[2]

[1]Optics and Photonics Research Group , University of Nottingham, United Kingdom, [1]Optics and Photonics Research Group, University of Nottingham, United Kingdom, [1]Department of Surgical & Interventional Engineering, King's College London, United Kingdom

Spatially Resolved Acoustic Spectroscopy has established itself as a powerful material characterisation technique capable of imaging the microstructure of a number of engineering alloys and semiconductor materials. The technique non-destructively utilises laser ultrasonics to robustly, rapidly, and repeatably measure controlled surface acoustic wave velocities – these can be mapped to image material grain contrasts (SRAS). This velocity is linked to the materials' elastic constants and local crystallographic orientation – as such, by establishing the wave phase velocity through multiple measurements at different directions and utilising published elastic constants values, the technique is able to extract the crystallographic orientation and map them as inverse pole figures (SRAS+). The cutting-edge research currently being undertaken is in utilising these measurements, an inverse solver and physical material limitations to determine the elastic constants themselves of both established and newly developed materials (SRAS++). This exciting expansion of the technique's capabilities allows for the imaging of not only material grain orientation, but also of the elasticities that constitutes the specimen, such as when required by graded or multi material characterisation. We present our work on the development of the technique over the last few years, and how we have put efforts into improving the image resolution and data capture rate on rough surface specimens.