Measuring Residual Stress in Parts Built Using Selective Laser Melting

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Selective Laser Melting (SLM) is an additive manufacturing technology that allows parts to be created from a laser melting metal powder in layer. Rather than traditional methods such a machining and milling which removes waste from a bulk material (Bo, Yu-sheng et al. 2012). It is because of the greater efficiencies presented with this new technology that additive manufacturing is considered to be at the forefront of the third industrial revolution (Markillie 2012).

SLM shows great promise to produce parts with unique geometry, minimal waste and short production times (Mumtaz, Erasenthiran et al. 2008). While processing issues of balling, density and surface finish are gradually being improved, the issues of deformation and residual stress are major problems (Mercelis and Kruth 2006). For the SLM technology to be utilised, an understanding of the formation and control of residual stresses must be established. As the layer thickness of the manufacturing process is small, approx 40μ, the techniques for analysing the residual stresses present must be carefully devised. A combination of neutron and synchrotron diffraction is to be used to analyse both macro and micro stresses in parts, utilising the advantages of both technologies. Experimental temperature profile logging and residual stress testing results are used alongside Finite Element Modelling (FEM) to quantify, predict and control these stresses.

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