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Material Properties and Residual Stress Measurements in Additively Manufactured 316L stainless steel components

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Additive manufacturing techniques, including Wire-Arc Additive Manufacturing (WAAM), present new opportunities to reduce manufacturing costs and minimise waste in diverse industries like aerospace, nuclear and civil engineering. WAAM is favoured over other metal additive manufacturing methods for this sector due to its high deposition rates and ability to produce large, complex structures without build environment limitations. Moreover, WAAM enables the creation of unique and customized geometries for structural parts, offering engineers unprecedented design flexibility and the potential for enhanced structural and corrosion-resistant properties - distinct advantages of additive manufacturing.

Currently, the broad industrial implementation of WAAM is held back by a lack of extensive systematic research and standardization. One of the major challenges is the limited understanding of residual stress distribution within built components, both in experimental and simulation settings. Given the expectation of a strong texture with large grain sizes, this study investigates the residual stress state using neutron diffraction and the contour method in 316L stainless steel components. This paper focuses on understanding the role of the material's texture and the residual stress distribution within large-scale WAAM components.

Topics

Manufacturing, Engineering and Industry

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