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# Microstructure and mechanical characteristics in a wire-arc additively manufactured component of low carbon steel and Inconel 625

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Wire-arc additive manufacturing (WAAM) is a state-of-the-art near net shape manufacturing technology that produces quality products with less size limitation compared to other AM methods. This study aims to compare the evolution of microstructure and the associate mechanical properties in components made from low alloy carbon steel (P22) and Inconel 625 (BAMS) using gas metal arc welding (GMAW) and plasma arc welding (PAW). The yield and ultimate tensile strengths of the fabricated component for the former were found higher than those of the latter. For both techniques, a narrow interface, with a width of ≈ 3 μm, was observed between the P22/Inconel 625 without the presence of any solidification cracks. Energy-dispersive x-ray spectroscopy (EDS) analyses across the interface showed a smooth transition in the chemical composition, with no measurable segregation of the alloying elements. The microstructure of the Inconel 625 exhibited the presence of solidification grain boundaries (SGBs) and solidification subgrain boundaries (SSGBs) along with Laves phases, while that of the P22 steel showed a ferritic-bainitic microstructure. The fracture surface of the tensile specimens showed that the Inconel 625 demonstrated equiaxed and parabolic dimples without the presence of any secondary particles, whereas Mn and Cr rich inclusions were observed on the fracture surface of the P22 steel.

*Keywords: Wire-arc additive manufacturing (WAAM), bimetallic additively-manufacture structure, GMAW, PAW, mechanical properties*