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Investigating the Effect of Varying Powder Size on Particulate Matter Emission and Mechanical Properties of In-Situ Micropowder Alloyed WAAM Depositions

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WAAM fabricates 3D products by laying molten filler wire in layers, resulting in final products with properties similar to the parent filler wire. However, In-situ micropowder alloying during WAAM can modify the deposited material without changing the parent filler material to enhance the mechanical properties. This research focuses on adding titanium and copper micropowders sandwiched between every carbon steel layer (ER70S6) in multilayered vertical walls. 50 μ m, 100 μ m, and 150 μ m powders were added to fabricate three separate walls. After deposition, the samples were extracted to study the effect of these varying powder sizes on the metallurgical and mechanical properties of the WAAM depositions. Results suggest enhanced mechanical properties with the addition of micropowders. However, adding micropowders could have a detrimental effect on the particulate emissions during the process. A detailed investigation of the fine and ultrafine particulate emissions was carried out using a scanning mobility particle sizer for the same experiments. The powder-alloyed depositions resulted in higher emissions than the as-deposited samples, especially in size ranges of 50-130nm. Results suggest that the size of the micropowders plays an important role in the emission characteristics and enhancement of the mechanical properties, and it could be possible to identify an optimized size range.