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A holistic approach for near-net-shape processing of iron aluminides by means of Laser Directed Energy Deposition with cored wires

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Iron aluminides are characterized by high corrosion resistance, excellent mechanical properties and dimensional stability at high temperatures. With a low density this material offers technological and economic advantages over Ni-based alloys in the aerospace sector. Because of the excellent mechanical properties machining is the current challenge in processing Fe-Al. Due to the possibility of near-net-shape manufacturing additive manufacturing processes such as L-DED with wires seem to be predestined for the processing of Fe-Al. In this paper, a holistic approach for processing Fe-Al including manufacturing of wires and the actual processing of the wires is described. Since the wire drawing of iron aluminides is not possible due to low forming characteristics, a rotary swaging process was applied for manufacturing cored wires with a steel shell and aluminum core. On the one hand, the usage of unalloyed raw materials with suitable forming properties are advantageous. On the other hand, cored wires require in-situ alloying of the steel shell and aluminum core during the application process. Thus, the weldability of such cored wires was investigated in preliminary tests, initially using a tungsten inert gas welding process. The wires and the welding results were characterized by scanning electron microscopy, computed tomography, and X-ray analyses.