Enhanced corrosion and wear resistance of wire-arc sprayed Al/Al_2O_3 composite coatings by a novel rotary swaging process

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Abstract Wire-arc sprayed Al-based composite coatings have been widely explored to protect steel components in marine environments. The proper regulation of ceramic reinforcements determines the performance of these composite coatings. In this work, a novel rotary swaging process was proposed to enhance the corrosion and wear resistance of wire-arc sprayed Al/Al_2O_3 composite coating in consideration of a improved depositon of ceramic reinforcements. The rotary swaging process efficiently enhances the cohesion strength of the filled powders within the cored wire, which enables a good ability to bear the vibration of arc force and facilitates heat transport, leading to the sufficient melt of high-melting-point Al_2O_3 particles. The deposition fraction of Al_2O_3 particles accordingly increases in the composite coating with a reduced interfacial flaw. The explored composite coating exhibites an excellent corrosion resistance in 3.5 wt.% NaCl aqueous solution due to the reduction of active area on electrode surface and the declined susceptibility to pitting. The wear rsistance of the composite coating is simultaneously improved because of the increased fraction of ceramic reinforcements and a dynamic self-reinforcement effect. The novel design demonstrates a great merit of promoting the application of Al/Al_2O_3 composite coatings and provides an inspiration for exploring the high-performance metal-matrix composite coatings prepared by wire-arc spraying.

Keywords Al-based composite coating, Rotary swaging process, wire-arc spraying, Corrosion behavior, Wear behavior