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Abstract

Bulk pellets and coatings of NiAl-Al_2O_3 composites on gray cast-iron substrates are fabricated by spark plasma sintering (SPS) at 700 and 1050°C using a highly reactive powder-mixture of "13Al+8Ni+3NiO" activated by 1 hour ball milling. The reactions are complete in all cases, except for the coating produced at the lower temperature. At both temperatures, the pellets experienced internal explosions, due to the intense reactivity of the powder, producing inhomogeneous microstructures. At 1050°C, the heat absorption from the substrates resulted in damped reactions producing homogenous, dense, fully reacted NiAl-Al_2O_3 composite coatings with crystallite sizes of 73nm and 65nm, respectively. A bond layer forms by growing into the substrate and diffusion of Fe, Ni, Al and Si is found in the coating, the bond layer and the substrate. In all cases, the adherence of coatings to substrates is good with no signs of pores or cracks. The products are examined by LOM, SEM, EDS, XRD, Vickers hardness indentation and scratch testing.

The SPS process is analyzed by FEM-simulations using a homogeneous reaction model where the properties are given by linear combinations of reactants and products. Melting

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