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Influence of rhenium addition on microstructure, mechanical properties and oxidation resistance of NiAl obtained by powder metallurgy

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Abstract

The search for new materials capable of replacing nickel-based superalloys in aerospace applications has increased rapidly in the recent years. One of the candidates for this purpose is nickel aluminide NiAl provided that its main drawback, namely the inferior fracture toughness at room temperature is overcome. We propose rhenium as an addition to NiAl to improve its mechanical properties without compromising on the oxidation resistance. Two powder metallurgy techniques (HP and SPS) were used to obtain NiAl/Re sinters. Small amounts of rhenium (0.6 at.%; 1.25at.%; 1.5 at.%) almost doubled the flexural strength of NiAl and improved its fracture toughness by 60%. Microscopic investigations revealed rhenium particles at the boundaries of NiAl grains resulting in an enhanced fracture toughness. Mass changes during oxidation at 900 °C, 1100 °C and 1300 °C were relatively low. Plausible mechanisms of the fracture toughness enhancement and the oxidation behavior are discussed.

Keywords: *nickel aluminide, rhenium, fracture toughness, oxidation resistance, powder metallurgy, grain boundary strengthening*

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