COMBUSTION SYNTHESIS OF MACROPOROUS β+γ'-NIAL ALLOYS[1]

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Intermetallic alloys have emerged with enormous potential for use in components for a wide variety of high-temperature industrial applications. The objective of this study is to determine the conditions for combustion synthesis of macroporous Ni-Al alloys with an ordered crystal structure β-NiAl+γ'Ni_3Al. Combustion synthesis was carried out on laboratory samples obtained by vibroforming of the reaction mixture Ni+Al (particle size of 5-100 micron, Al concentration 13-30 wt.%) in cylindrical mould (diameter 20-40 mm, height 40-80 mm). It has been found that without using any additives, the synthesized materials are characterized with microporous and cracks structure (fig 1, a). To obtain macroporous materials without structure defects CaO and $CaCO_3$ additives were used. The additives are capable to melt or decompose in the combustion wave zone, which provides two effects. Firstly, the chemical composition of additives should act as a flux for the destruction of the oxide layers on the surface of reagents and activate the capillary interaction of the melts. Secondly, the generated gas must loosen a layer of the reaction mixture. This allows creating a thermal gap between the combustion zone and the heating zone. This approach allows one to realize an oscillatory combustion mode and obtaining the high-permeability alloys (fig 1, b,c). The XRD patterns showed cubic B2 β-NiAl and $L1_0$ γ'Ni_3Al as the major structures of the synthesized materials (fig 1, d). The minor amounts of the $L6_0$ Ni_3Al were also revealed, which annealed after 1000 °C one hour treatment. Electron microscopy also revealed only B2 and $L1_0$ phases in annealed materials (fig 1, e).

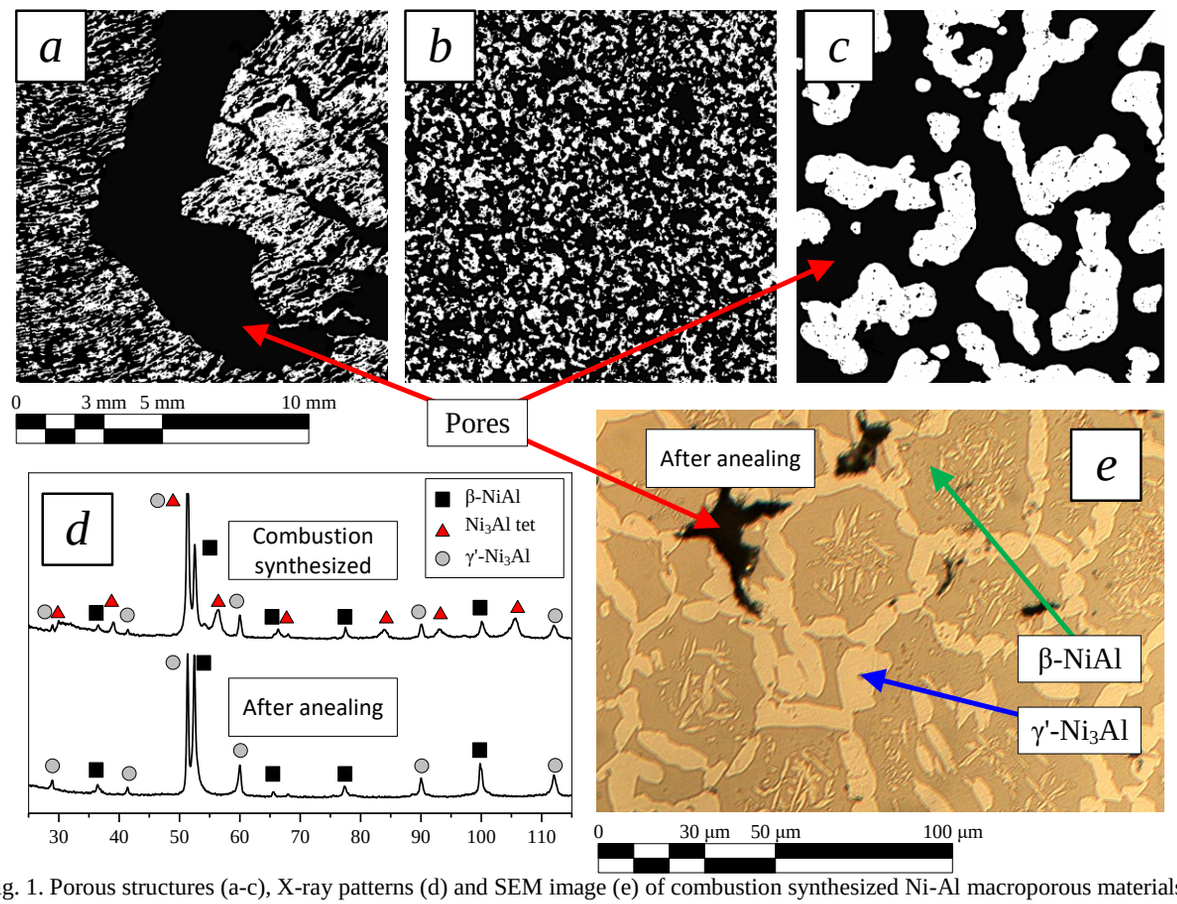

Fig. 1. Porous structures (a-c), X-ray patterns (d) and SEM image (e) of combustion synthesized Ni-Al macroporous materials.

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