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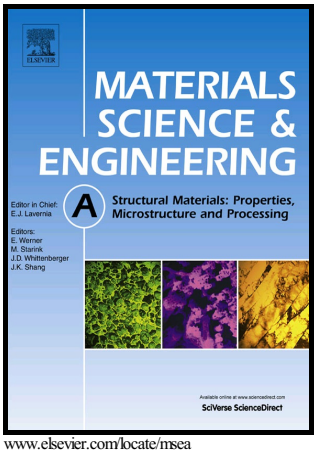

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Abstract

In this paper, the concept, microstructure and properties of the Ni-Cr-Ta-Al-C complex phase alloy are presented. The alloy was designed to work at elevated temperatures, in a chemically aggressive environment and under harsh wear conditions. The alloy was examined in an as-cast state and after heat treatment using a number of complementary techniques such as: scanning electron microscopy, 3D reconstruction by means of focused ion beam-scanning electron microscopy, transmission electron microscopy, X-ray diffraction, nanoindentation, dilatometry, hardness measurements and in-situ tensile tests at elevated temperatures. The microstructure of the alloy is comprised of a dendritic chromium-rich nickel-based matrix, which is strengthened by spheroidal precipitations of the γ' $Ni_3(AlTa)$ phase as well as Chinese script-like TaC and Cr_7C_3 carbides. Analysing hardness and microstructural changes of the alloy after solution treatment and after aging in different conditions allows to optimise the alloy's heat treatment procedure. It was found that the alloy achieved the highest hardness values after aging at 800°C, which is related with the evolution of the γ' phase. Additionally, it was discovered that primary carbides are stable up to at least 1150°C, which is promising from the viewpoint of working at elevated temperatures and under harsh wear conditions. The herein reported results show that the combination of eutectic carbides and ordered γ' phase for strengthening and, possibly, improving wear resistance of the alloy is effective up to at least 850°C.

Keywords: Ni-based alloy, Alloy design, Microstructure, Carbides, Heat resistant material