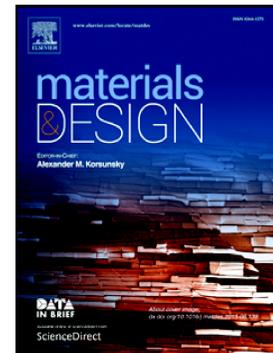


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Composition design, phase transitions of a new polycrystalline Ni-Cr-Co-W base superalloy and its isothermal oxidation dynamics behaviors at 1300 °C

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Abstract: The composition, phase transitions and isothermal oxidation dynamics of a new polycrystalline Ni-Cr-Co-W base superalloy are investigated using CALculation of PHase Diagrams (CALPHAD), Differential Scanning Calorimetry (DSC), ThermoGravimetric analysis (TG/dTG), Scanning Electron Microscope and Energy Dispersion Spectrum (SEM/EDS) methods. The microstructure of the designed alloy shows a uniform γ matrix with the precipitates of rich-Ti cellular η and rich-Nb acicular platelet δ phase, and no Topologically Close-packed Phases (TCPs) observed, and the oxide behavior obeys a parabolic law with a parabolic constant (k_p) 2.945 $\text{mg}^2/(\text{cm}^4\cdot\text{h})$ at isothermal 1300°C for 30 hours. The oxide scales are composed of an outer loose oxide mixture containing Cr, Ni, Ti and Nb/Ta and generous pores presented for a volatilization of Cr_2O_3 , and a dense aluminum-rich oxide layer.

Key words: Nickel base superalloy; Composition design; Phase transition; Isothermal oxidation dynamics

1 Introduction

Nickel base superalloy (nickel content more than 50 wt. %) has a good ability of anti-oxidant, fatigue and creep resistance, high strength and structural stability at elevated temperature [1-4], it is widely used in the aerospace field for turbine engine components, such as working blade, combustion chamber, turbine disk and adjustment sheet etc. [5, 6].

The properties of the superalloys depend on the additions of different alloying elements, such as Cr, Co, Mo, W and V are added for solid solution alloys, and elements of Al, Ti, Nb and Ta are added generally for precipitate strengthened alloys. In addition, the supplementary elements such as B, Zr, Mg and rare earth elements are often present in recent developed superalloys for complementary strengthening.

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