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Microstructural Investigation and Oxidation Performance of Nickel?Based Superalloys

Bouyegh Saida, Retima Mohamed, TLILI Samira, Djamel Eddine Mekki, Hassani Mohamed, Graine Radouane

Abstract: An as-received IN738LC blade root material has been firstly characterized, in order to appreciate its structural, micro-structural and morphological properties. Different observations and analysis (OM, XRD, SEM/EDS, etc.) showed that our sample is mainly constituted of ?´ precipitates in a Ni-rich matrix (? solution), a ?/?´ eutectic and some carbides. After that, the oxidation behavior of IN738LC superalloy has been investigated to assess the oxidized formed layers. For this purpose, isothermal oxidation experiences have been carried out at 950 and 1150 °C for various times (24h, 48h and 72h). The differ- ent microstructures of oxides and substrate obtained after oxidation tests were observed and analyzed by scanning electron microscopy (SEM/EDS). The oxidation kinetics were monitored by samples weight change with time. Composition and phase evolutions, mean crystallite size and strain appeared in this superalloy, were determined by X-ray diffraction (XRD) patterns. Last, the adhesion of the growing oxides onto the substrate was evaluated by the scratch test. The main results of these investigations reveal that microstructure parameters strongly depend on temperature and durations of the process. Moreover, the oxidation kinetics of the alloys follows a parabolic rate law both at 950 °C and at 1150 °C. From XRD and EDS analysis, the major phases seen are Cr2O3, TiO2, Al2O3, NiO and NiCr2O4, which contribute to a better oxidation resistance. The oxide scales increase with time and temperature, they are compact, dense, distributed uniformly and adherent at 950°C/72h, while they are relatively larger and non-uniform at 1150 °C. On the other hand, the adhesion of the oxides at 1150°C is fairly weak, and oxidation products flake off quite easily, which indicated weakening of the protection.

Keywords : Turbine blade, Inconel 738LC, Oxidation kinetics, microstructure, Strain, Adhesion