Structural Evolution of Mechanically Alloyed Ni-Cr-Al-Y Powders

Jorge Morales¹, Oscar Velázquez de Jesús², Viviana Leyva Hernández³

¹Centro de Investigación y Desarrollo Tecnológico en Electroquímica, Science, Mexico. ²Centro de Investigación y Desarrollo Tecnológico en Electroquímica, Posgrade, Mexico. ³Instituto Tecnológico Superior de Ébano, Academic development, Mexico.

Mechanical alloying process has been employed for the synthesis of nano-crystalline composite powders. MCrAlY system of commercial applications is used like bond coatings between the thermal insulating ceramic topcoat and the underlying load-bearing superalloy component for gas turbine application. The purpose of this study is to know the structural evolution of the nanostructured NiCrAlY powders and evaluate their corrosion-oxidation resistance at high temperature. Structural evolution in the compositions Ni-Cr₁₀-Al₄₀, Ni-Cr₂₅-Al₂₅ and Ni-Cr₄₀-Al₁₀ (in wt%) were studied during the mechanical alloying of the elemental powders of Ni, Cr and Al with an average particle size of 50 µm during 108 Ks (30 hours) of milling under inert atmosphere. The milled powder were characterized by X-Ray diffraction (XRD) every 6 hours to follow the progress of the mechanical alloying. Over saturated solid solution of Al and Cr in Ni (Ni(Cr,Al)) was observed in the first 64.8 Ks of milling for Ni-Cr₄₀-Al₁₀ composition; the compositions with a higher content of aluminum needed 86.4 Ks of milling to form the over saturated solution. At 108 Ks were identified the compound Ni(Cr,Al) and NiAl para Ni-Cr₂₅-Al₂₅ and Ni-Cr₁₀-Al₄₀. After heat treatment at 1173 K (900 °C) for 3.6 Ks under argon atmosphere the phases Ni₃Al, Ni(Cr,Al) and NiAl co-exist for all compositions. The crystallite size calculated with the Scherrer equation was 9 nm average at the end of milling process. An agglomerated morphology was observed with a range of particle size between 500 and 800 nm that varies with the increase of the aluminum content.

Keywords: Mechanical Alloying, MCrAlY, Corrosion-oxidation resistance

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Presenting author’s email: ovelazquez@cideteq.mx