

Properties of a Dense Nanostructured FeAl Produced by MAFAPAS

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A MAFAPAS (Mechanically-Activated Field-Activated Pressure-Assisted synthesis) process combining electric field activation and the imposition of pressure from mechanically activated powder mixtures is demonstrated to simultaneously synthesize and consolidate nano-FeAl in one step. Fe + Al powders were co-milled in a specially designed planetary ball mill to obtain nanometric reactants but to avoid the formation of any product phases. These were introduced inside the FAPAS chamber and were subjected to high AC current (1500A) and pressure of 70 MPa. Under these conditions, a reaction is initiated and completed within a short period of time (from 2 to 5 min). The process allows the production of a dense nanostructured FeAl (80 nm). In addition, the relative density of the end-product ranged from 97 to 99%. The behaviors of these dense nano-FeAl (i.e. thermal stability, high temperature corrosion resistance and electrochemical corrosion resistance) were investigated : (i) the corrosion and passivation behavior of nano-FeAl was studied in sulfuric acid media using potentiodynamic curves; (ii) isothermal and cyclic oxidation tests in the temperature range 800 – 1100°C were performed to check their ability to form protective alumina scales and to test their adherence to the alumina scale. The results show the same general type of active-passive-transpassive behavior as those of the polycrystalline bulk FeAl extruded material and promising corrosion resistance properties.