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AISI 310 STAINLESS STEEL MATRIX COMPOSITE FORMED BY GELCASTING

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Resumo:
Gelcasting (GC) is a fluid forming technique that allows the use of a wide variety of powders in its preparation, including ceramic and metallic particles. Additionally, as it is based on the preparation of a powder suspension, excellent powder dispersion can be attained with the help of adequate surfactants and stirring procedure. These characteristics are suitable for the fabrication of composite materials consisting of a continuous phase (matrix) reinforced by a discontinuous phase (reinforcement), which are usually obtained by powder metallurgy techniques. Nonetheless, the use of gelcasting technique to produce metal matrix composites (MMCs) is still scarce. This work describes the fabrication of a metal matrix composite consisting of HK-30 (AISI 310) stainless steel reinforced with additions of 1, 3 and 5 wt.% of nanosized alumina particles by means of the gelcasting process. Prior to specimen preparation, special attention was given to the powder suspensions and to the interaction between metallic and ceramic particles, which is one of the central aspects of this study. HK-30 and alumina average particle sizes are 8 μm and 600 nm, respectively. A previous thermal analysis was held in order to define the sintering temperature and assure that any issues regarding to densification would be avoided. Images obtained by scanning electron microscope and optical microscope were taken and X-ray diffraction analysis of slices of a sintered sample was done to evaluate the dispersion of alumina particles in sintered stainless steel matrix composite samples. Compression tests were performed at room temperature and at 800°C, in addition to microstructural characterization of sintered parts, which were compared with previously obtained results. The effect of particles settling was assessed by measuring density and yield strength of specimens taken from random position of the sintered part, and the dispersion of results along the vertical axis was negligible, even though the density results were lower than the theoretical results. The maximum yield strength achieved by this study was 195 MPa for room temperature and 95 MPa for 800°C, both for specimens with alumina addition of 3 wt.% overcoming the results that were previously obtained.The gelcasting process showed to be feasible for obtaining metal matrix composite parts, with good mechanical properties and low manufacturing cost.