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AISI 310 stainless steel matrix composite reinforced with alumina particles

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Gelcasting is a fluid forming technique that allows the use of a wide variety of powders in its preparation, including ceramic and metallic particles, at any solids concentration. Composites materials consist of a continuous phase (matrix) in which a discontinuous phase (reinforcement) is distributed over several in various volumetric fractions, sizes, shapes and distribution, which directly affects the modification of mechanical, physical and chemical properties of the matrix. Both gelcasting and MMC have been thoroughly investigated in the last decades, nonetheless, the suitability of the gelcasting process to obtain particles reinforced MMCs is still scarce in the literature. This work describes the application of the gelcasting process for preparing a metal matrix composite consisting of HK-30 (AISI 310) stainless steel reinforced with small additions of nanosized alumina particles. Prior to specimen preparation, special attention was given to the rheology of the suspension and to the interaction between metallic and ceramic particles, which is one of the central aspects of this study. HK-30 and alumina particle sizes are 10µm and 600nm, respectively. A thermal analysis was held in order to define the sintering temperature and assure that any issue regarding to densification would be avoided. Images obtained by scanning electron microscope (SEM) and optical microscope were taken from a slices of a sintered sample 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 microharness and microstructural characterization of the sintered ones, and then compared to previous work. The minimum yield strength achieved by this study was 270 MPa for room temperature and 105 MPa for 800°C, overcoming the results that were previously obtained. The gelcasting process showed to be feasible for obtaining dense metal matrix composite parts, with good mechanical properties and low cost of manufacturing.