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Abstract

Aqueous Gelcasting of Complex-Shaped Zircon Compacts †

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Zircon, or zirconium silicate ($ZrSiO_4$), is a ceramic material widely known for its excellent thermal properties, such as low thermal conductivity and high resistance to thermal shock. This makes it an ideal material for obtaining coatings used as thermal barriers and other structural applications.

In this work, dense zircon complex-shaped parts have been obtained by means of polysaccharide gelation. For this purpose, concentrated solutions of the biopolymer agar, which is a natural biopolymer extracted from the cell walls of several species of algae, and whose production involves low environmental impact, were used. A colloidal stability study was performed for the zircon particles by means of Z-potential measurements as a function of both the pH and the concentration of a polyacrylic-type anionic polyelectrolyte (PAA), which acts as a deflocculant. A rheological study of the different zircon suspensions was also carried out, varying the total solids content and the dispersant concentration, as well as the sonication mixing time. For this objective, the corresponding flow curves were measured first at room temperature and, once the conditions were optimized, the rheological study of the suspensions with the polysaccharide, which was added in a solution, was performed. To conclude the rheological studies, viscosity versus temperature curves were recorded for the zircon–agar mixtures, observing the gelation process of the material at around 35 °C.

Once the green pieces were obtained, dynamic sintering (0–1600 °C) and static sintering (1550 °C and 1600 °C) tests were carried out, studying the shrinkage and densification of the material. Finally, a phases evolution study and the microstructural characterization of the sintered parts at different temperatures were performed using X-ray diffraction (XRD) and scanning electron microscopy (SEM) techniques.

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