THE INFLUENCE OF CARBON ON THE MICROSTRUCTURE OF SINTERED ALUMINA

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Alumina is one of the most used ceramic materials, and as such understanding its sintering and densification processes is important. It is known that the sintering behavior is strongly affected by dopants, such as MgO, which promotes sintering and limits grain growth. The present study focuses on the influence of carbon on the sintering of alumina. Commercial ready-to-press (RTP) alumina specimens were sintered to full density (98%) at 1600°C for 2 h in air and in a graphite furnace using flowing He, a reducing atmosphere. The specimens sintered in graphite furnace resulted in a black color, an indication of the high carbon content originating from the large amount of organic compounds in RTP powders. In comparison, alumina specimens sintered in air, where the carbon decomposes during sintering at elevated temperatures, were white. Sintering with carbon in under He resulted in specimens with a finer microstructure. The presence of carbon retards grain growth, most probably by solute drag. A uniform segregation of carbon to the grain boundaries of alumina was shown by atom probe tomography [1]. In order to evaluate the wear resistance of the sintered alumina, the time (normalized by area) to section specimens with a diamond wafer blade was determined. The time to section specimens containing carbon was more than 40 times longer compared to the specimens sintered in air. The combination of reducing atmosphere and high carbon content has a positive effect on the microstructure and mechanical properties of alumina.

[1] Marquis, E. A., Yahya, N. A., Larson, D. J., Miller, M. K. & Todd, R. I. Probing the improbable: imaging C atoms in alumina. Mater. Today 13, 34–36 (2010).