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Monte Carlo Simulation of Microstructure Development in Alumina via Densification and Grain Growth

Most ceramic components are manufactured using a powder sintering process. The ceramic microstructure develops through the interaction of densification and grain growth, which is influenced by various process factors. Therefore, computer simulations are crucial. Among the various simulation techniques, the Monte Carlo (MC) method is a prominent approach. In this study, sintering experiments were conducted using alumina powders of different sizes. Corresponding MC simulations of densification and grain growth were then performed to verify the method's effectiveness. The experimental results showed that higher temperatures activated both densification and grain growth. Notably, the kinetics of fine powder were faster than those of coarse powder, resulting in a larger grain size in the sintered body developed from fine powder. The computational parameters in the MC simulation were determined by referencing the experimental data, successfully reproducing the observed densification and grain growth behavior. Furthermore, simulations were conducted under varied conditions, followed by corresponding experiments. The simulations reproduced the experimental results, demonstrating that microstructural development in alumina is predictable. Therefore, the MC method is a highly promising technology for designing microstructures in sintering processes.
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Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

No interest

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Yes

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