

Non-Equilibrium Relaxation during the Cold Sintering Process

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Materials perturbed to non-equilibrium conditions will spontaneously relax to their equilibrium state. The cold sintering of ceramics can be understood in this way. Throughout the cold sintering process (CSP), various diffusional and creep mechanisms transfer material from grain boundaries to porous regions to drive densification. Here, we will show that a relaxation model can be used to describe these diffusional mechanisms during the CSP. Zinc oxide cold sintered with acetic acid is used as a model system. Under isothermal conditions we will show that the observed relaxations are first order in nature and characterized by a single time constant. Via a Fast Fourier Transformation (FFT) of the shrinkage data, concurrent relaxations are separated. Respective sintering data is assessed in the perspective of a modified Kingery two particle model. An initial relaxation is identified as a dissolution aided particle rearrangement, and the second as pressure solution creep. Temperature and pressure effects on each relaxation time is studied. The activation energy and characteristic relaxation time calculated from isothermal experiments will then be shown to readily predict densification behavior under non-isothermal conditions. Utilizing the relaxation model, the effects of various polymer additives and chemistries on the kinetics and microstructural evolution during CSP are discussed.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

Journal of the European Ceramic Society (Elsevier)

Invitation letter for visa

No

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