A SOLID MECHANICS APPROACH FOR CERAMIC PROCESSING AND PROPERTIES CHARACTERIZATION

Hector Camacho Montes[1], Yoanh Espinosa Almeyda[1], Jesus Gamboa[1], Lorenzo Barraza[1], Antonino Vega Siverio[1], Irma Espinoza[1], José Antonio Otero[2], Reinaldo Rodríguez-Ramos[3], Boris Jesús Mederos Madrazo[1], Federico J Sabina[4], Rajendra K Bordia[5]

[1]Universidad Autónoma de Ciudad Juárez, Física y Matemáticas, Mexico. [2]Instituto Tecnológico y de Estudios Superiores de Monterey, Escuela de Ingeniería y Ciencias, Mexico. [3]Universidad de La Habana, Matemática y Computación, Cuba. [4] Universidad Nacional Autónoma de México, Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, Mexico. [5]Clemson University, Materials Science and Engineering, United States.

Ceramic processing deals with a large number of parameters to be controlled. In addition to this, the connection among processing variables is usually larger than expected. One solution to deal with this situation can be Statistical Processing Control (SPC). However, analytical approaches are also a promising tool to control and characterize ceramic processing and sintering. Densification And deformation can be described during sintering. Constitutive laws to describe the macroscopic behavior of powder compacts during sintering is a problem that has attracted the researcher's attention for decades. The applications of these laws allow to describe densification and shape deformation during sintering. Structural parameters as grain size are possible to be included. FEM simulation allows to obtain maps to describe the density, stress, and deformation distribution in order to have a better characterization of macroscopic deformation during sintering. The viscous parameter that describes sintering can also be obtained in a sinter forging unit and considered for the simulation process. This could be a more direct way to characterize sintering for a constrained system, for example, a bilaminar layer where high stresses can be developed at the interphase. In addition, the estimation of effective properties for polycrystal is developed based on a homogenization technique applied to a representative volume element (RVE) with the help of Finite Element Method (FEM). Applying this model, the effect of the crystallographic texture and grain size distribution on the ceramic properties can be estimated considering the interaction at grain boundaries, which provides a more realistic analysis of the material properties. The viscous properties for sintering description as well as effective properties depend on structural parameters that can be connected. Therefore, solid mechanics offers considerable potential to describe the powder sintering - polycrystal structure -properties relationship.

Keywords: solid mechanics, sintering, effective properties

Acknowledgment:

Presenting author's email: hcamacho@uacj.mx