Foundations of Ceramic Processing

Learn the key principles in ceramic processing, focusing on defect prevention, powder characterization, forming techniques, and a brief introduction to sintering.

Students will examine factors affecting strength, warping, and cracking, alongside methods like colloidal processing, granulation, and sintering. Emphasis is placed on rheology, particle packing, and the use of a Specific Volume Diagram approach to optimize manufacturing processes. Quality control strategies will also be discussed to ensure reliable ceramic components.

Class Dates	Topics / Activities During Class	Assignments, Notes, Demos
1) 06/11/2025	Why is powder processing necessary? Review of mechanical properties and brittle failure of materials. Cracking and warping: drying and sintering.	Students will be provided with selected readings, with each lecture, that provide additional background.
2) 06/13/2025	Powder characterization: density, specific surface area, particle size distributions. A new approach to particle size analysis. Particle size measurement. Particle packing.	A 2-parameter approach to particle size distribution analysis.
3) 06/18/2025	Introduction to rheology. Rheology measurement. The 5 Factors that control suspension rheology. Colloidal behavior and stabilization.	Rheology and Plasticity in Ceramic Processing
4) 06/20/2025	Slip casting and tape casting. Plastic forming processes. Specific volume diagrams for plastic forming. Extrusion and vibratory casting. Dry pressing and isostatic pressing. (A critique of Additive Manufacturing)	A holistic approach to ceramic forming processes
5) 06/25/2025	Drying, calcining, pyrolysis, sintering, and microstructure characterization.	Sintering, two-step sintering, microstructure evolution.
6) 06/27/2025	Quality control testing. Trouble-shooting a process. The need for statistics.	Use of statistical analysis and Weibull analysis for process assessment.

Additional References or Resources:

1. Glossary of Ceramic Terminology.
2. Handouts posted as course content and presentations.
3. Book recommendations, as appropriate (there are few that are relevant).