

# Sintering Behavior of Highly-porous Nanostructured Materials

Macroporous ceramics are interesting for a wide range of applications, including catalysis, sensing, photonics, biomedicine, and energy conversion. Many applications require materials that retain their intricate porous architecture at high temperatures, where sintering-related transformations can otherwise degrade structural integrity and functionality. In this talk, I will present metal-oxide isoporous multiscale ceramic structures fabricated via atomic layer deposition (ALD) and their response to thermal exposure. Discrete element method (DEM) and finite element method (FEM) simulations is used to explain the structural evolution and mechanical response of highly-porous  $\text{Al}_2\text{O}_3$  structures. Our findings reveal that the pore size distribution and volumetric arrangement critically influence thermal deformation, with a complex interplay between geometric parameters and mechanical performance. Building on these insights, we demonstrate the fabrication of thermally robust  $\text{ZrO}_2\text{-Al}_2\text{O}_3$  and  $\text{SiO}_2\text{-Al}_2\text{O}_3$  macroporous systems. Their enhanced resistance to sintering, phase stabilization, and suppression of grain coarsening are attributed to the combined effects of nanoscale structuring and the uniform phase distribution achieved through ALD super-cycling. This approach establishes a pathway toward designing next-generation macroporous ceramics with exceptional thermal and mechanical stability for advanced functional applications.

## Professional Status of the Speaker

Senior Scientist

## Interest in submitting a paper in a special issue of

No interest

## Invitation letter for visa

No

**Authors:** Mr GOMEZ-GOMEZ, Alberto (Netsch); Dr RIBAS GOMES, Diego (Karlsruhe Institute of Technology (KIT), Institute for Applied Materials, Ceramic Materials and Technologies (IAM-KWT)); PAGNAN FURLAN, Kaline (Karlsruhe Institute of Technology (KIT), Institute for Applied Materials, Ceramic Materials and Technologies (IAM-KWT))

**Presenter:** PAGNAN FURLAN, Kaline (Karlsruhe Institute of Technology (KIT), Institute for Applied Materials, Ceramic Materials and Technologies (IAM-KWT))

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