

# Reactive pathways in zirconia based ceramics processing : when chemistry meets sintering

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Yttria-stabilised zirconia (YSZ) is a key material in advanced ceramics, widely used in structural, biomedical and energy applications. Its processing relies on energy-intensive heat treatments, notably high-temperature sintering above 1400 °C. These processes have a significant environmental impact and, for biomaterials applications, lead to trade-offs between mechanical, optical properties and resistance to low temperature hydrothermal degradation. Recently, major efforts have focused on low-impact processing routes to reduce energy consumption. Wet chemical methods and non-conventional sintering processes, such as Spark Plasma Sintering and Cold Sintering, directly address eco-design challenges in ceramics. Reduced sintering temperatures and/or short sintering times enable the design of nanostructured ceramics, allowing optimized zirconia properties. However, these approaches raise questions on the mechanisms involved and the relationships between micro/nanostructures and properties. We propose strategies exploiting chemical reactivity combined with non-conventional processes within specific temperature windows, creating synergy between chemical reactions and densification. These strategies rely on reactive precursors, hydroxides and nanoparticles smaller than 10 nm, enabling enhanced reactivity and microstructure control. The results highlight the critical balance between densification and phases stability, the complexity of the mechanisms involved are discussed.

## Professional Status of the Speaker

Senior Scientist

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

No interest

## Invitation letter for visa

No

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