

# Engineering UO<sub>2</sub> Microstructures via Enhanced Grain Growth Sintering Methods for Next Generation Nuclear Fuels

A recent reinvigorated shift in interest of nuclear energy, has resulted in demand for enhanced new nuclear fuel ceramics which possess enhanced safety and efficiency margins, to increase energy output and reduce spent nuclear fuel inventories. In industry, this has primarily been achieved through the doping of UO<sub>2</sub> with Al, Cr and Al/Cr mixtures a part of so-called “accident tolerant nuclear fuel programs”. The additions result in improved grain growth resulting in increased fission gas retention and enhanced microstructural performance. Despite their current in reactor deployment, the individual roles and effects of Cr and Al on the UO<sub>2</sub> microstructure and mechanical behavior remain poorly described. Particularly understanding how precise control on dopant addition, associated redox chemistry, combined with specific sintering conditions leads to optimized ceramic microstructure development. This work has focused on examining the microstructural, chemical and mechanical performance of UO<sub>2</sub> ceramic pellets doped with Cr, Al and Cr/Al. Specifically, the work will describe the need to consider dopant redox states, balanced against secondary phase formation which can either detriment ceramics, such as via Zener pinning, or improve them, through enhanced grain coalescence. The work will highlight and discuss next directions in nuclear ceramic oxide materials, and their enhancement via precise microstructure control via strategic sintering and preparation methods.

## Professional Status of the Speaker

Senior Scientist

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

Journal of the European Ceramic Society (Elsevier)

## Invitation letter for visa

No

**Authors:** Dr MURPHY, Gabriel (Forschungszentrum Juelich GmbH - Institute of Nuclear Waste Management); BRANDT (Forschungszentrum Juelich GmbH); BUKAEMESKIY (Forschungszentrum Juelich GmbH); JIMENEZ (Forschungszentrum Juelich GmbH); KLINKENBERG (Forschungszentrum Juelich GmbH); SHIROKIY (Forschungszentrum Juelich GmbH); KEGLER (Forschungszentrum Juelich GmbH)

**Presenter:** Dr MURPHY, Gabriel (Forschungszentrum Juelich GmbH - Institute of Nuclear Waste Management)

**Session Classification:** Microstructure evolution during sintering and Microstructure-property relationships

**Track Classification:** Group 1: Microstructure evolution during sintering and Microstructure-property relationships