Jie Lian et al., Res. Rev. J Mat. Sci. 2018, Volume 6
DOI: 10.4172/2321-6212-C2-018

4th International Conference on

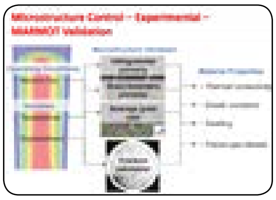
Condensed Matter and Materials Physics

August 16-17, 2018 | London, UK

Advanced fuels by field assisted sintering technology: Accident tolerance and fuel performance model validation

Jie Lian, Tiankai Yao and **Bowen Gong**
Rensselaer Polytechnic Institute, USA

The advanced ceramic fuel development program is exploring revolutionary ceramic fuels with the potential of "game-changing" impact on reactor operation and response to beyond design scenario. Key properties of advanced fuels include high thermal conductivity, oxidation resistance, high temperature mechanical properties, and thus improved accident tolerance. Composite ceramic fuels possess distinct advantages to fulfill these key requirements. In addition, the US Nuclear Energy Advanced Modeling and Simulation (NEAMS) program is developing science-based next generation fuel performance modeling capability to facilitate the predictive capability of nuclear fuel performance and critical experimental data are needed to validate the multiscale multiphysics MARMOT models. In this talk, recent advancements of using field-assisted sintering technologies, specifically spark plasma sintering (SPS), in fabricating advanced fuels and engineering fuel matrix as the target systems will be reviewed. Different types of concepts are explored for the advanced fuel designs including graphene-based UO_2 composite fuels, large-grained fuel doped by oxide additive and the high uranium density fuel, and the impact on design of accident tolerant fuels were discussed. Recent progresses of using SPS in tailoring and engineering fuel matrix as the target systems for validating MARMOT physics models will also be highlighted. Particularly, monolithic oxide fuels with tailored microstructure including grain size across multiple length scales from nano-metered to micron-sizes, porosity and stoichiometry can be sintered. The impacts of tailored microstructure on thermal-mechanical properties and grain growth kinetics are discussed within the context of the MARMOT modeling.



Recent Publications:

1. Tiankai Yao et al. (2018) Radiation-induced grain subdivision and bubble formation in $U3Si_2$ at LWR temperature. Journal of Nuclear Materials. 498:169-175.
2. Y Miao et al. (2017) Bubble morphology in $U3Si_2$ implanted by high-energy Xe ions at 300°C. Journal of Nuclear Materials. 495:146-153.
3. Tiankai Yao et al. (2017) Growth and pore coarsening in dense nanocrystalline UO_{2+x} fuel pellets. Journal of American Ceramic Society. 100(6):2651-2658.
4. Yinbin Miao et al. (2017) *In situ* Synchrotron Investigation of Grain Growth Behavior of Nano-Grained UO_2. Scripta Materialia. 131:29-32.
5. Yinbin Miao et al. (2016) Correlation between crystallographic orientation and surface faceting in UO_2. Journal of Nuclear Materials. 478:176-184.

Biography

Jie Lian received his PhD degree in Nuclear Engineering & Radiological Sciences from University of Michigan in 2003 and his M.S. degree in Materials Science & Engineering from Tsinghus University at 1998 and Electrical Engineering from University of Michigan in 2001. He obtained his B.S. degree in Materials Science and Engineering from Yanshan University in China in 1995. He joined the Department of Mechanical, Aerospace & Nuclear Engineering at Rensselaer Polytechnic Institute as an Assistant Professor in 06/2008 and was promoted to Associate Professor with tenure at July 2013. He was promoted to full professor at July 2017.

lianj@rpi.edu