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# Direct validation of numerical twins of nuclear fuel microstructures with the help of micro-tomography

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The  $UO_2$  ceramics under consideration display a more-or-less connected and extended network of intergranules pores.  $3D$  virtual microstructures of these ceramics are under development to capture the dominant effect of this porous network on their effective thermal conductivity (see [1]). These virtual microstructures derive from a morphological model depending on a limited number of parameters (see [2]). In [3], these parameters have first been tuned in order to mimic optical images of the real ceramics and then virtual microstructures have been partially assessed by  $2D$  full-field thermal simulations. To strengthen this validation process, the ceramics under consideration have been imaged in  $3D$  by synchrotron X-Ray micro-computed tomography, with a specific setup adapted to the very strong attenuation of  $UO_2$ . As expected, these images allow qualitative and quantitative comparisons between observed  $3D$  porous networks and simulated ones. In addition, these images make possible direct comparisons of full field  $3D$  thermal computations between real and virtual microstructures.

[1] Moutin et al., 2022, Nuclear Material Conference, Ghent, 2022

[2] Meynard et al., 2022, J. Mech. Phys. Solids , 158, 04647

[3] Moutin et al., 2023, International Journal of Solids and Structures, 275, 112249