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Production of Surrogate Fuel Plates with Monolithic Gradient Foils

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ABSTRACT

The neutronic and thermalhydraulic design of some high-flux research reactors like FRM II requires a variation of the uranium loading in radial direction of the fuel plates, in order to reduce localized thermal spikes. For disperse fuels, like currently used at FRM II, this can be achieved with a step-wise reduced fuel powder loading in the aluminum matrix. With the proposed conversion of these reactors to lower-enriched uranium using monolithic fuels, metallic fuel foils with a thickness gradient will thus become necessary.

Recently, the European production process for monolithic UMo fuel, which has been successfully demonstrated for the EMPIrE fuel fabrication, was optimized and adapted to this complex geometry. Inert gradient foils out of stainless steel were produced by high-precision machining and alternatively by selective laser melting by TUM. The diffusion barrier layer was applied to these foils by an adapted TUM PVD coating process. The optimized Framatome C2TWP cladding application process was used to produce surrogate fuel plates with gradient foils.

The great flexibility of these processes was demonstrated by the successful production of several plates with machined and additively manufactured foils within specification.