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Investigation of the temperature-dependent failure processes in a PVD Cr-coated ZIRLO nuclear fuel cladding material using real-time X-ray micro-tomography imaging

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Zirconium alloys (Zircaloys) are widely used as fuel cladding in LWRs but suffer rapid oxidation in high-temperature steam, compromising structural integrity. Cr coatings, especially those applied via physical vapour deposition (PVD) method, offer improved oxidation resistance and mechanical stability. According to open literature, the 3D real-time failure process of such material under mechanical loading at extreme temperatures remains poorly understood.
This study investigates the deformation and fracture of one PVD Cr-coated Optimized ZIRLO® cladding material under C-ring compression loading using real-time synchrotron X-ray computed tomography (XCT) at temperatures up to 950 ℃ in argon atmosphere, and post-tested SEM and EBSD analyses were performed to support XCT observations and assess temperature-dependent damage mechanisms.

Author: Dr YUAN, Guanjie

Co-authors: Prof. LIU, Dong; Dr ŠEVEČEK, Martin

Presenter: Dr YUAN, Guanjie

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