Abstract: Crystal plasticity modeling of nanoindentation in ITER-relevant W/Cu joints.

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The divertor, one of the main parts of the International Thermonuclear Experimental Reactor (ITER), extracts the heat and radiating species generated by the fusion reaction. The divertor contains various sub-assemblies, each comprising numerous components made of copper-chromium-zirconium (CuCrZr) cooling ducts which are joined to tungsten (W) monoblocks using a copper (Cu) interlayer. The W/Cu joint is paramount not only for efficient heat exhaustion but also for maintaining the structural integrity of the divertor under the extreme environmental conditions expected at ITER; thereby its assessment is crucial. It is in this regard that the present work aims to understand the mechanical behavior across W/Cu joints through FEM modeling of nanoindentation. A crystal plasticity model implemented a user-defined material law that allowed grain-scale FE modeling of the plastic strain field and lattice distortions expected after nanoindentation in the close vicinity of a W-Cu joint. The influence of the local lattice orientation and the proximity of the joint was investigated by comparing numerical predictions to experimental observations. The further simulation of heat cycles provides insights that could be useful for further assessment of ITER monoblocks.

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