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P2.116 Inverse identification of Tungsten static recrystallization kinetics

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For the ITER divertor, plasma facing components are made with tungsten as armour material, bonded on a coper alloy tube as heat sink structural material and cooled by water. Such components withstand high heat flux up to 20 MW/m2 and consequently satisfy ITER requirements. However, due to high heat flux, the loaded surface can reach extreme temperature values from 2000℃ and strong temperature gradients are generated on a thickness of 6 mm. 2000℃ is large enough to alter the tungsten microstructure by recrystallization causing mechanical properties losses and then damages such as macro cracks in the material. Understanding of recrystallization phenomenon is essential to apprehend damage process of tungsten armored components and to optimize their use in tokamak environment. Previous, numerical studies proved that recrystallization phenomenon play an important role in the damage process of the tungsten armored component. Up to now, uniform tungsten recrystallized layer thickness was assumed in numerical simulations to predict plastic strain increments and then perform life time calculations.
In this paper, a way of modelling tungsten recrystallization is proposed. To reach this goal, experiments are performed to study recrystallization kinetics of tungsten up to 1800℃ thus completing experimental data available in literature limited at 1350℃ [1]. Each obtained recrystallization kinetic is fitted to Johnson-Mehl-Avrami-Kolmogorov (JMAK) model. This phenomenological model is able to describe recrystallization kinetics as an exponential function useable in finite elements code. In this way, based on isothermal recrystallization kinetics gathered by A.Alfonso et al [1] and our experiments, numerical simulations coupled with JMAK model are achieved to model tungsten recrystallization. Using these experiments data and dedicated simulations coupled with JMAK model, consistent recrystallization gradient are estimated compare to that obtained experimentally during high heat flux campaigns.

[1] "Alfonso Lopez et al, (2015). Thermal stability of warm-rolled tungsten. DTU Mechanical Engineering".

Presenter: DURIF, Alan (IRFM CEA)

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