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Modelling of chemical vapor deposition to improve tungsten fiber reinforced tungsten composites (Wf/W)

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Due to the unique combination of excellent thermal properties, low sputter yield, hydrogen retention and activation, tungsten is the main candidate for the first wall material in future fusion devices. However, its intrinsic brittleness and its susceptibility to operational embrittlement is a major concern. To overcome this drawback, tungsten fiber reinforced tungsten composites featuring pseudo ductility have been developed. Bulk material can be successfully produced utilizing chemical vapor deposition of tungsten fabrics. However, a fully dense composite with a high fiber volume fraction is still a huge challenge.

Therefore, a model is currently developed in COMSOL including the complex coupling of transport phenomena and chemical reaction kinetics. To validate the model with experimental data, fibers were deposited in heated tubes under controlled parameter variation. The temperature and tungsten growth rate were measured along the fibers and inner tube surfaces for different heater temperatures, partial pressures and gas flows. With the experimental results the prediction of the model has been improved. As next step the model will be applied to design infiltration experiments to fabricate fully dense Wf/W composites with a high fiber volume fraction.

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