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Hydrogen permeation studies on fusion materials and the influence of interfaces on the permeation: Gas-driven permeation measurements on bulk and layered substrates and hydrogen retention studies

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Fuel retention and permeation in the wall of future fusion devices are among crucial factors for the reactor safety and its economical operation. For the prediction, evaluation and calculation of hydrogen permeation and retention in fusion reactor walls, it is essential to know fundamental parameters of hydrogen transport and retention.

In order to obtain such basic parameter for hydrogen isotopes, gas-driven permeation measurements have to be performed. For hydrogen retention studies, thermal desorption spectroscopy (TDS) measurements have to be carried out on relevant gas loaded materials. With nuclear reaction analysis (NRA) the hydrogen depth distribution can be quantified. In order to investigate the influence of the microstructure and sample conditions, sample characterization is crucial before and after permeation and retention measurements by surface analysis techniques.

Various fusion relevant bare substrate materials, such as steels, tungsten and CuCrZr will be studied. Especially for the prediction of the hydrogen retention and permeation through fusion reactor components, the influence of interfaces on the permeation and retention of magnetron-coated substrates will be investigated. For a deeper understanding of the permeation and retention processes in fusion materials, a reaction-diffusion model will be applied. With these studies combining complementary methods, the prediction, evaluation and calculation of hydrogen permeation and retention in fusion reactor wall materials and components will be enabled.

In this presentation, the work plan and methods of our group related to this CRP will be discussed and first results will be shown.

Primary author: HOUBEN, Anne (Forschungszentrum Juelich GmbH)

Co-authors: Dr MATVEEV, Dmitry (Forschungszentrum Jülich GmbH); Dr GAO, Liang (Forschungszentrum Jülich GmbH); Dr MÖLLER, Sören (Forschungszentrum Jülich GmbH); UNTERBERG, Bernhard (Forschungszentrum Jülich); Prof. LINSMEIER, Christian (Forschungszentrum Jülich GmbH)

Presenter: HOUBEN, Anne (Forschungszentrum Juelich GmbH)

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