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P3.110 Temperature dependence of hydrogen co-deposition with metals

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Hydrogen co-deposition with sputtered particles is one of the main channels of hydrogen isotope accumulation in today's tokamaks. According to experiments in tokamaks and in labaratory conditions hydrogen concentration in co-deposits show that can be very high (up to tens of atomic percents) for various materials at low deposition temperature even in the case of low hydrogen solubility. This is explained by presence of a high concentration of defects in the deposited films, and therefore, temperature dependences of hydrogen accumulation in co-deposits are very different for various materials due to difference in energy characteristics of defects in materials.
In the present work, we propose a model of H co-deposition with metals and an analytical formula for H/Me ratio in the deposited film. The model predictions were compared, firstly, with experimental results on W-D co-deposition [1], where W-D co-deposited layers were produced by means of DC magnetron sputtering of W target in Ar/D working gas mixture with the substrate temperatures T varying from RT to 800 K with the step of 30 K. The deposited layers were analyzed by means of in-vacuo thermal desorption spectroscopy (TDS) with no contact of the sample with air. The experimental dependencies of D/W vs T had several steps of D content decrease, and the proposed model described the experimental features well in all the temperature range used.
Similar experiments were repeated for two other materials: molybdenum and aluminum. The experimental results were also well described by the model.

[1] S.A. Krat et al, Vacuum, 149 (2018) 23-28

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