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Hydrogen atom recombination on tungsten at high temperature: a combined experimental and theoretical work

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The realization of future fusion reactors has revealed the need of new data on hydrogen recombination on several kinds of materials at high temperature level. In the literature, one can found only data at low temperature for different materials (silica, stainless steel, some pure metals and carbon). Today tungsten appears one of the most promising materials with respect to graphite and beryllium as plasma-facing material to use in magnetic fusion energy devices, both on the divertor and first-wall in tokamaks. Therefore it seems necessary to perform measurement of the recombination coefficient of atomic hydrogen at higher temperature levels. For this reason, in the last years, a large interest both experimental and theoretical was focused on this material and its interaction with hydrogen and its isotopes [1, 2].

In this contribution, we propose a joint experimental and theoretical investigation on hydrogen atoms interaction with a W(110) surface following a previous study we have performed on atomic oxygen interaction on quartz [3].

The experimental part is performed using the MESOX experimental set-up to evaluate the recombination coefficient of atomic hydrogen, based on the measurement of the relative concentration profiles $H\beta/H_2$ or $H\alpha$/He by optical emission spectroscopy [4, 5]. Experimental results obtained for the recombination coefficient of hydrogen atoms (γ_H) are obtained for tungsten from 700 to 1350 K.

These latter are compared with the results obtained in Molecular Dynamics (MD) simulations based on the semi-classical collisional method [6] for the recombination reaction between an atom adsorbed on the surface and an atom impinging from the gas phase. The simulation was done for the W(110) surface at two temperatures of 700 and 1000 K, for normal incidence of H atom hitting the surface and for collisional energies in the range 0.05-6 eV. The effect of adsorption site on the reaction dynamics was also evaluated.

A fairly good agreement between the experimental and calculated data was obtained.

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