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Vibrational excitation of hydrogen molecules formed by atom recombination on tungsten

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The production of vibrationally excited hydrogen molecules by recombination processes on a tungsten surface exposed to hydrogen is relevant to the understanding and development of hydrogen negative ion sources (e.g. [1, 2]) and to a lesser extent to the modelling the edge plasma in tokamaks (e.g. [3, 4]).
Here we present an overview of our studies of the vibrational distributions in H2 and D2 molecules produced by atom recombination on tungsten [5]. In our experiments, we exposed a tungsten surface to a steady flow of atomic hydrogen and measured the vibrational distribution of desorbed molecules. Vibrational distributions were determined by specific spectrometers utilising the properties of dissociative electron attachment in hydrogen. We performed measurements in a few different experimental arrangements [6, 7, 8]. Measured populations of vibrational states roughly follow Boltzmann distribution corresponding to vibrational temperature between 2800 K and 3800 K [6, 7]. Observed vibrational temperature is lower for D2 than for the H2 [7]. Measurements in H2 [6] also clearly reveal that the rotational temperature is significantly lower than vibrational one. Some measurements also indicate a possible departure of the Boltzmannian state distributions [8]. We will discuss our experimental results by addressing recent theoretical studies of hydrogen-tungsten interaction (e.g. [9] and references therein).
We also provide some general discussion on our spectroscopic method, which is well suited for studies of vibrationally excited hydrogen isotopologues in order to promote its future use as well as to suggest possible further applications.

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