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Probing vibrational levels of ground state hydrogen molecules by laser photodetachment

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In this work, a study of the vibrationally excited hydrogen molecules formed via recombinative desorption of hydrogen atoms on surfaces of selected materials is performed. Assuming that dissociative attachment of low energy electrons is the main generation channel of hydrogen negative ions [1], highly excited states of molecules ($H_2(X^1\Sigma_g^+, v'' \geq 5)$) can be correlated with thenegative ion density [2].

In order to focus on the recombinative desorption of atoms, a two stage/chamber configuration is employed. In the first stage, a filament maintained at moderate temperature (~1500 K) dissociates hydrogen molecules and provides an abundant density of atomic hydrogen, which then recombine on the walls of the chamber [3,4]. The material of the chamber can be conveniently changed and its temperature is controlled.

The highly excited molecular hydrogen generated inside the first chamber escapes through a nozzle into the second chamber. Here, four dipolar sources [5] are used as a source electrons [6] of controlled temperature. From the combination of cold electrons and highly excited molecules, negative ions are generated and measured by the photodetachment technique [7].

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