# Dissociative electron attachment to $H_2$ molecules involving the $^2\Sigma_g^+$ resonant Rydberg electronic state



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# Dissociative electron attachment to $H_2$ molecules involving the $^2\Sigma_g^+$ resonant Rydberg electronic state.

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**Synopsis** Dissociative attachment process involving a resonant Rydberg-excited $^2\Sigma_g^+$ electronic state of the $H_2^-$ molecular ion: influence of the vibrational excitation of the target molecule and isotopic effect.

The dissociative electron attachment (DEA) process for molecules plays a decisive role in many hydrogen plasmas. The importance of DEA in the negative ion sources, for instance, is well known; in these sources, the production of the $H^-$ species comes mainly from dissociative attachment to vibrationally excited $H_2$ molecule, and the formation of these ions is dramatically enhanced if the nuclear modes of the molecules are highly excited. In general, the DEA process plays a significant role in all non-equilibrium hydrogen plasmas, in which a strong non-Boltzmann distribution generates a high density of vibrationally and rotationally excited $H_2$ molecules.

We present in this communication, DEA cross sections for the process [1]

$$H_2(X^1\Sigma_g^+, v_i) + e \rightarrow H_2^-(^2\Sigma_g^+) \rightarrow \\ \rightarrow H^-(1s^2) + H(n=2) \qquad (1)$$

where the incident electron $e$ is temporarily trapped by the $H_2$ molecule, initially in its $v_i - th$ vibrational level, giving rise to the formation of the transient species $H_2^-$ in the Rydberg-excited electronic state $^2\Sigma_g^+$, whose dissociation yields to a stable negative ion $H^-$ and an excited hydrogen atom in the quantum state $n = 2$. Our aim is, in particular, to investigate the effect of the vibrational excitation of the target molecule on the dissociative attachment cross section.

The theoretical calculations have been performed in the frame of the well-known local potential model, particularly suitable for processes involving long-lived resonant species, and whose accuracy has been tested in previous calculations [2, 3]. Figure 1 shows an example of DEA cross sections for process (1), as a function of the incident electron energy and for some values of the vibrational quantum number $v_i$. A complete set of cross sections, along with the corresponding rate coefficients, covering the whole vibrational spectrum of the $H_2$ molecule, and for the case $v_i = 0$ of the other five isotopic variants, will be presented at the conference.

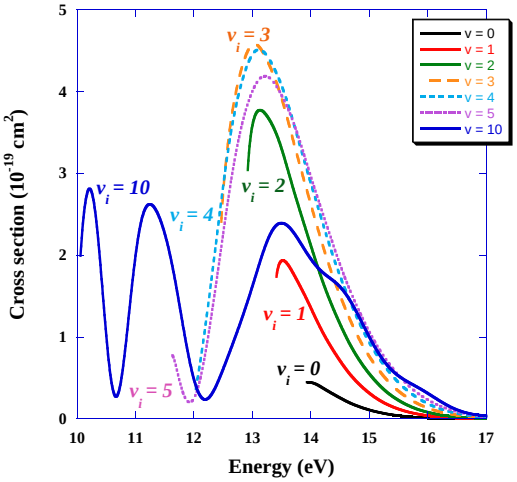


**Figure 1**. Cross section for process (1) as a function of the incident electron energy and for the $v_i = 0 - 5, 10$ vibrational levels of the $H_2$ molecule.

## References

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