Recombination of H_3^+ with electrons in afterglow plasma in hydrogen

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Recombination of H_3^+ ions with electrons in stationary afterglow plasma in hydrogen at 240-340 K was studied using near-infrared (NIR) absorption spectroscopy (SA-CRDS). The plasma is formed in a pulsed microwave discharge in a mixture of He-Ar-H_2 and the densities of three rotational states of the ground vibrational state of H_3^+ during the afterglow are measured using the transitions $3v_2^1(2,0) \leftarrow 0v_2^0(1,0)$ and $3v_2^1(4,3) \leftarrow 0v_2^0(3,3)$ for ortho-H_3^+ and $3v_2^1(2,1) \leftarrow 0v_2^0(1,1)$ for para-H_3^+. Details and notation are discussed in refs. [1,2]. The decay of the plasma is then analysed to obtain an "effective" recombination coefficient α_{eff}. From dependence of the measured α_{eff} on hydrogen density [H_2] binary rate coefficient (α_{bin}) and ternary H_2-assisted recombination rate coefficient (K_{H2}) are obtained. We found that the ternary process is by five orders of magnitude more effective than process described by classical theory of Bates and Khare [3] for ternary recombination. The value of the binary recombination rate coefficient is in agreement with generally accepted value [4,5,6].

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