Analysis of the possibility of using the emission of molecular hydrogen triplet states for the diagnostics of non-equilibrium microwave discharge in hydrogen

Shakhatov V.A. and Lebedev Yu.A.

Topchiev Institute of Petrochemical Synthesis, Russian Academy of Sciences, Moscow, Russia, [lebedev@ips.ac.ru](mailto:lebedev@ips.ac.ru)

Analysis of the applicability of spectral methods for diagnostics of microwave discharges using the emission of triplet states of molecular hydrogen was fulfilled on the base of developed kinetic model. Zero-dimensional collisional – radiative model (CRM) of hydrogen low-temperature plasma developed for the solution of the task, differs from the models described in the literature in that it simultaneously consider the kinetic processes of hydrogen molecules in the singlet (2,   
2, 3, 3, 4, 4, 2, 3, 3, 3, 3, 4,   
4, 4, 4, ) and triplet (2, 2, 2, 3, 3, 3,   
3, 3, 4, 4, 4, 4) electron excited states. This model is the development of models that are described in detail in [1–7].

It is established that the mechanism of population-depopulation of triplet states is different for different states and depends on the residence time of hydrogen molecules in the discharge zone, gas pressure (concentration of heavy particles) and concentration of electrons. Secondary processes provide the smallest contribution to the generation and loss of triplet states , ,  and  at pressure 1 Torr and electron density108–1011 cm–3. This conclusion is valid also for states  и  at pressure 8 Torr. Тор. At 18 Тор contribution of secondary processes in the population of states , ,  and  is minimal only at low electron density (108 cm–3). In these cases the optically allowed transitions , ,  and  are of interest for optical diagnostics of hydrogen microwave discharges.

Because the EEDF in microwave discharge and DC discharge in hydrogen differ weakly [13], we can assume that the results will be valid for the DC discharge at the same concentration of electrons.

References

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