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VUV-diagnostics of inelastic collision processes in low temperature hydrogen plasmas

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Inelastic collision processes of hot electrons (Ee>9 eV), such as ionization and electronic excitation, have a crucial role on the performance of negative (H□) and positive (H+, H+ 2) hydrogen ion sources. Direct diagnostic of those processes is extremely challenging due to their sensitivity to the high energy tail of the electron energy distribution function (EEDF). Vacuum ultraviolet (VUV) emission of molecular hydrogen plasmas can be utilized as a robust diagnostics for molecule ionization, dissociation and production rates of high vibrational levels (n>5) and metastable states. The method is based on comparison of the rate coefficients of the given processes to the excitation rate coefficients of the lowest excited states. Because of similar threshold energies and functional shapes of cross sections the method is only slightly sensitive to the variation of the EEDF and other plasma parameters. The principle of the diagnostics and with a robust method to measure absolute VUV-emission are presented. Practical ways to apply these methods to (mechanical) development of hydrogen ion sources are discussed, as well as the possibility to use the obtained reaction rates support the development and benchmarking of plasma simulation codes.