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PROCESSES WITH NEUTRAL HYDROGEN AND DEUTERIUM MOLECULES RELEVANT TO EDGE PLASMA IN TOKAMAKS

I. ČADEŽ, S. MARKELJ, Z. RUPNIK, P. PELICON
Institute Jožef Stefan, Jamova cesta 39, 1000 Ljubljana, Slovenia
E–mail: Iztok.Cadez@ijs.si

Abstract. Detailed understanding and characterization of plasma-wall interaction and edge plasma in present tokamaks and future fusion reactors is becoming more and more important due to the ITER project. Involved processes determine the physical and chemical sputtering of the wall material, fuel retention in exposed material, edge plasma properties, disruption phenomena etc. Neutral hydrogen atoms and molecules are present in the edge plasma. They are continuously generated by ion recombination on the wall of the fusion reactor and on the other plasma facing components and subsequently reemitted in the plasma. Neutral molecules are especially important for plasma detachment in tokamak divertors. The interaction of excited neutral molecules with the walls and their importance for the edge plasma is still not well understood since there are not many experimental studies of relevant processes. Moreover, spectroscopic results from tokamak edge plasma are dominated by processes involving ions and electrons, so that direct evidence of the influence of neutrals is difficult to extract. Direct correlation of the observed phenomena to the processes with neutrals is mainly possible by numerical simulations.

We have constructed a set-up for vibrational spectroscopy of hydrogen molecules (H_2 and D_2) that is based on the properties of the dissociative electron attachment in hydrogen in order to facilitate dedicated experimental studies of relevant processes with hydrogen molecules. For the same purpose we also developed a technique for in-situ hydrogen depth profiling on the samples exposed to the controlled hydrogen atmosphere. This is done by Ion Beam Analytical (IBA) method ERDA (Elastic Recoil Detection Analysis), utilizing 4.2 MeV probing beam of $^7Li^{2+}$ ions. A short description of experimental techniques and results on chemical erosion of graphite layers, production of vibrationally excited hydrogen molecules on tungsten and isotope exchange on tungsten are to be presented in this report.