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DIAGNOSTICS OF PLASMAS IN AND IN CONTACT WITH LIQUIDS

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During the last two decades plasmas in and in contact with liquids have received a lot of attention in view of their considerable environmental and bio-medical applications [1,2]. These applications exploit the complex and rich plasma chemistry of these often highly transient plasmas.

The kinetics of the radical production in plasmas is as usual determined by the electron density (n_e), the electron temperature (T_e) and the neutral temperature (T_g). However the presence of water in both gaseous and liquid state in the discharge strongly enriches the plasma chemistry and pushes these discharges to a higher level of complexity. The large amount of different water containing plasma sources, studied all over the world, span a range of energy efficiencies which vary up to 5 orders of magnitudes for the same application [3]. This large discrepancy is often not thoroughly understood and clearly illustrates the necessity of an accurate knowlegde of the basic processes and the necessity for good and reliable diagnostics of the basic plasma parameters: T_e, n_e and T_g.

Due to the often limited accessibility of active (laser) diagnostics and the complicated plasma geometries (often submerged in liquid), optical emission spectroscopy (OES) is mostly used as a diagnostic tool to investigate plasmas in liquids. The typical strong emission of OH(*A*–*X*) and of the hydrogen Balmer lines in water containing plasmas provide a means for obtaining gas temperatures and electron densities [4][5]. However the interpretation of these spectra needs to be done with care. As is well known, electron temperature determination from OES remains a challenging topic for furture research.

Experimental results of the OH(A-X) emission spectra showing non-equilibrium behaviour in a large range of different water containing plasmas will be discussed. The strongly different plasma conditions of different experiments enable us to extract information on the production mechanisms of OH(A) and their influence on the rotational population distribution of OH(A). The two main processes enabling this rotational non-equilibrium at atmospheric pressure: electronic quenching of OH(A) and ro-vibrational energy transfer will be discussed in detail [6][7]. Gas temperatures obtained by OES and laser scattering experiments will be compared and discussed in detail.

Nano-second time resolved optical emission of sub-microsecond pulsed discharges in bubbles will be presented and discussed in the context of excited species production. In these high

density plasmas with an ionization degree of 10^{-3} recombination processes are the dominant production mechanism of excited species [8][9].

Examples of mass spectrometry measurements in cold atmospheric pressure water containing plasmas [10] will be also discussed in the context of the importance of negative ions in the chemistry of low temperature water containing plasmas.

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