High Spatial Resolution Measurements of the Electric Field in a Hollow Cathode Discharge

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Hollow cathode discharges (HCD) are the subject of an intense research mainly due to the increasing number of technological applications. To improve all these applications it is very important a clear understanding of the different mechanisms involved in the discharge [1]. The local electric field strength (E-field) is one of the most relevant discharge parameters because it is connected with charged particle fluxes, their energy distribution functions and the charge densities. In this type of discharges (HCD) the E-field distribution shows a very strong gradient in a very short region adjacent to the cathode surface (dark space), where almost the entire potential applied between the electrodes drops off. As a consequence E-field measurements demand a high spatial resolution. This work is dedicated to study the E-field in the dark region of a HCD in different experimental conditions of pressure and current; using two gasses: hydrogen or deuterium [2, 3]. With the results it is possible to compare in detail similarities and differences in the tendencies of the cathode fall characteristics of a HCD operated in both gasses, hence the similarities and differences will be only related to the change of atomic and molecular mass by a factor of two (D with respect to H), while all other atomic and molecular parameters (e.g. dissociation and ionization energy) are nearly identical.

The E-field strength was determined via the Stark splitting of the 2S level of the atomic hydrogen isotopes using Doppler-free two-photon optogalvanic spectroscopy. The E-field varies from 0.5 kV/cm to 4 kV/cm in the cathode fall region of about 2 mm. The exceptional high spatial resolution provides by the optogalvanic detection in our experiment [4] gives reliability to the obtained experimental results, which we will show at the Conference, i.e.: maximum E-field at the cathode surface, cathode sheath thickness, and variations of the cathode fall voltage drop versus pressure and current.

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