Publ. Obs. Astron. Belgrade No. 53 (1996), 23 *Invited lecture*
Приглашенный доклад

SPECTROSCOPIC STUDIES OF AN ANALYTICAL GLOW DISCHARGE

N. KONJEVIĆ, M. M. KURAICA and I. R. VIDENOVIĆ
Faculty of Physics, University of Belgrade, P.O.Box 368, 11001 Belgrade, Yugoslavia
E-mail nikon@rudjer.ff.bg.ac.yu

Here we present the results of the spectroscopic diagnostics of the plane cathode Grimm-type glow discharge. In the first part, results of the plasma diagnostics of negative glow region will be discussed in details.

Special attention is devoted to the study of the influence of working gas and cathode material on the shape of hydrogen Balmer lines. It is shown that the lower part of these lines, emitted by the discharge in hydrogen and in the Ne-H2 and He-H2 mixtures, are appreciably broadened. Analysis of these profiles indicates that scattering and excitation of hydrogen on the sputtered cathode material and working gas in the vicinity of the cathode play an important role in the line shape formation.

For the measurements of the electric fields in a cathode fall region, Stark spectroscopy of the hydrogen Balmer lines is employed. The consistency in results obtained from Hb and Hg recordings in pure hydrogen discharge is found. Some difficulties in applying Stark spectroscopy for the diagnostics of spatially inhomogeneous electric field inherent to Grimm glow discharge will be discussed in details. The experimental results are used to test theoretical predictions of the electrical field distribution in the cathode fall region. Reasonable agreement between theories and experiment is reported.

Doppler spectroscopy of the same Balmer lines is used to determine the energies of the excited hydrogen atoms in the discharge. In the cathode fall region of pure hydrogen discharge, two groups of excited atoms are detected : "slow", in the range from 3.4 eV to 8.2 eV and "fast", ranging between 80 eV and 190 eV. Relative concentrations of "slow" and "fast" excited hydrogen atoms in the cathode fall region are determined. In addition, relative concentration of hydrogen atoms with temperatures around 0.1 eV, excited in the plasma of negative glow region, is determined as well. The origin of "slow" and "fast" hydrogen atoms is related to the presence of H+ and H3+ ions respectively. In the cathode fall region of argon-hydrogen mixture discharge, excited hydrogen neutrals with energies between 32 eV and 43 eV are detected only. Their origin is related to the dominant role of H3+ ion in this discharge. For both gases, in the negative glow region, an increase of the exited hydrogen atoms temperature is detected, and explained by the additional excitation of energetic neutrals in collisions with electrons.

The axial intensity distributions of hydrogen Balmer lines show, in comparison with other atomic and ionic lines, different shapes with maximum in the vicinity of the cathode surface. These shapes are explained by excitation of reflected high energy neutral atoms in collisions with matrix gas.