ON THE FEATURES OF ELECTRIC FIELDS CHARACTERIZATION IN DC ATMOSPHERIC PRESSURE HELIUM DISCHARGES USING POLARIZEDSTARK SPECTROSCOPY

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The effect of fluctuations in the discharge current on the Starks broadening components of helium and hydrogen lines in the cathode fall layer of the potential is investigated. The oscillations are analyzed with the use of elements of chaos theory.

Polarized Stark spectroscopy is frequently used for electric field determination in plasma. In this report we consider some features of its applications in dc atmospheric pressure helium discharges starting from Townsend discharge and terminating at a high-current glow discharge. These discharges and their characteristic regions have quite different plasma conditions leading to the H_β (486.1 nm) and He I (492.2 nm) line profiles broadening.

In Townsend discharge, electron concentration is extremely low and gas temperature is close to room temperature. Therefore, the main broadening mechanism of Stark components of H_β line is a Wan-der-Waals broadening (~0.05 nm). At a fitting of H_β line profile from region located close to anode, we obtain electric field about 5 kV/cm.

In a cathode fall layer of glow discharge in helium, the Stark components of H_β as well as He I line are strongly broadened (Fig. 1*a*). The performed analyze of possible broadening mechanisms in this layer shows that such strong line broadening is caused by fluctuations of discharge parameters in megahertz range due to anode spots [1]. These fluctuations do not effect significantly the line profiles in the other discharge regions.

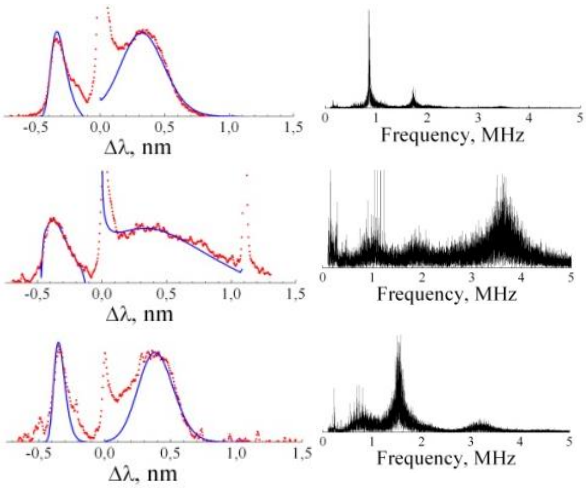

Fig. 1. *The measured and simulated (solid) He I 492.2 nm line shapes (left column) and spectra of current fluctuations*

Electric field in cathode layer is represented as: $E = E_0 + E_\sim$, where E_0 is constant component of electric field and $E_\sim$ is its variable one. So, $E_0$is~60 kV/cm and $E_\sim$ is ~17 kV/cm close to cathode surface. Shapes of H_β and He I lines in the cathode fall depend on admixtures of other gases in helium. In Fig 1 the shapes of He I line with of argon (*b*) and nitrogen (*c*) admixtures are shown. It can be seen, the profile becomes more broadened in the first case and more narrow in the second case in comparison with helium discharge. That is accompanied with changing of a discharge current fluctuation spectrum and an anode spots picture. Discharge current fluctuations are analyzed with an involvement of the elements of chaos theory.

REFERENCE

1. V.I. Arkhipenko et al. *Plasma Sources Sci. Technol.***17** (2008) 045017