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ESTIMATION OF NITROGEN IMPURITY LEVEL IN HELIUM ATMOSPHERIC DISCHARGE VIA EMISSION SPECTROSCOPY

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Abstract. In the last two decades nonthermal atmospheric pressure discharges have emerged as the most investigated and most promising laboratory plasma sources (see e.g. Brandenburg, 2019). These discharges are predominantly dielectric barrier discharges (DBDs) operating in noble gases. Research has shown that presence of gas impurities within the working gas can be crucial for DBD operation, in some cases even for providing its sustenance. Numerous models have shown the influence of gas impurity level on discharge parameters (see e,g. Martens et al. 2010, Wang and Wang 2005, Zhanf et al. 2019). Therefore, the knowledge of impurity level is required both in experimental work and for reactor design. Here we propose a spectroscopic method for the estimation of nitrogen molecular impurity in discharge operating in helium, which is a typical working gas/impurity combination. The method is based on the intensity ratio of the prominent N_2 band ($C^3\Pi u$–$B^3\Pi g$, 0-0) at 337 nm, and the strong atomic line HeI (3^3S-2^3P) at 706 nm. A collisional-radiative model was developed to obtain a functional dependance of intensity ratio on the impurity level, at a given reduced electric field. In connection, an experimental study was performed to investigate the influence of gas flow rate on a closed chamber helium DBD (Ivković et al. 2022). Namely, the aim of the experiment was to investigate the presumed connection between the gas flow rate and the impurity level, and consequential change of the discharge operation. Using the abovementioned spectroscopic method, a strongly non-linear decrease of impurities concentration with increasing working gas flow rate was observed.

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