Measurement of active species concentrations in nitrogen and argon/nitrogen flowing afterglows at reduced pressure.

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Nitrogen containing post-discharges at reduced pressure (1-20 Torr) are today widely used in numerous surface treatments such as steel nitriding, modification of wettability or of adhesion properties. In the late afterglow region, the flowing gas is free from agressive charged species but still contains large amounts of reactive species (atoms, metastable and vibrationally excited molecules) flowing at room temperature. For these reasons, flowing afterglows are particularly well suited to the cold sterilization of the medical instrumentation.

During the last 15 years, the antibacterial capabilities of nitrogen/oxygen [1-3] and of pure nitrogen flowing afterglows [4-5] have been studied. In this last case, a 6 log reduction of an initial bacterial concentration (i.e. a sterilization) was obtained either at room temperature with a high microwave power (P_{MW} = 300 W) injected in the discharge or for an operating temperature of 60°C with a lower injected microwave power (100 W).

For both cases, the concentration of the nitrogen atoms (which were proven to be the sterilization agent) was shown to be higher than 10^{21} m^{-3}. The present paper is devoted to the characterization of the late afterglow region of N_2 and Ar/N_2 flowing discharges. Results will be presented concerning the variations of the gas temperature and of the concentrations of the high lifetime species such as the nitrogen atoms, the vibrational levels of the molecular fundamental state $N_2(X, v)$ and the metastable species $N_2(A)$ with the operating parameters (pressure, microwave power, gas flow rate). For $N_2(A)$, the spectroscopic method recently developed by Pointu and al. [6] was adapted to the reduced pressure range, conducing to a maximum concentration of 2.6 10^{16} m^{-3}, in good agreement with the values already published in the litterature [7].

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