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Determination of O-atom density in impurity in the afterglows of N2 microwave discharges

andré RICARD[1], hayat Zerrouki[2], Jean-Philippe Sarrette[2]

[1]LAPLACE Univ. Paul Sabatier, toulouse, France [2]LAPLACE, toulouse, France

ricard@laplace.univ-tlse.fr

N_2 and N_2 – O_2 flowing microwave discharges and afterglows are largely studied at medium gas pressures (1-20 Torr) where it has been observed early and late afterglows .
It is presently studied the flowing afterglows produced from N_2 microwave plasmas by emission spectroscopy and by NO titration to determine the density of N-atoms . The intensities of the N_2 1^{st} pos , N_2^+ 1^{st} neg. and NO_β bands are recorded to characterize the early and late afterglows.
A microwave N_2 flowing discharge was produced in a dia.6 mm quartz tube at a flow rate Q = 1-3 Slm , a power between 100 and 300 Watt and a gas pressure varying from 4 to 20 Torr. The afterglows was detected downstream in a 21 mm dia.tube. It has been found that for the chosen conditions of Q=1 Slm and 150 Watt , the early afterglow is about half a pink afterglow with emission of the N_2^+, 1^{st} neg. at 391.4 nm. and about half a late afterglow with a strong emission of N_2 , 1^{st} pos at 580 nm.NO_β and CN emissions have been detected in the early afterglow . They are a signature of O and C – atoms impurities into N_2.
By titration with NO , it has been measured the variations of N-atom density with gas pressure.Then , it has been determined the O-atom density by comparing the NO_β (320 nm) and N_2(580 nm) bands intensities.In the studied discharge conditions (1 Slm , 150 W) , it is found increases of the N – atom density from 0.9 to 2.1 10^{15} cm^{-3} and of the O-atom density from 0.7 to 2.8 10^{12} cm^{-3} with the gas pressure from 4 to 16 Torr. It corresponds to an O-atom impurity into N_2 in the order of 5ppM.
It appears that the N_2^+(391.4 nm)/ NO_β (320 nm) ratio is very sensitive to the O_2 impurity with a decrease of N_2^+(391.4 nm) by the $N_2^+ + O_2$ charge transfer and an increase of NO_β (320 nm) by the N+O recombination.The O_2 impurity into N_2 will be calibrated from variations of the N_2^+(391.4 nm)/ NO_β (320 nm) intensity ratio with small introduced O_2 quantities into pure N_2.

Keywords
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