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Density of active species in the flowing afterglows of Ar-N2 RF and HF plasmas

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Active species in RF and microwave (HF) afterglows of Ar-N2 gas mixtures were studied under similar flowing reactors : small discharge quartz tubes (dia.5-6 mm) directly connected to chambers of dia.15-20 cm , at low gas pressures (2 – 6 Torr) , flow rates of 0.4– 1.0 slm and a constant power of 100 W. These experiments were undertaken to investigate surface treatments , specifically sterilization processes , in afterglow conditions . Densities of N-atoms, N2(X,v > 13) and N2(A) metastable molecules N2+ ions and O-atoms in impurity have been measured using the line ratio intensity method after calibration of N-atom density by NO titration. It is obtained in diffuse HF afterglows at (10-3 s after the plasma) the following density values :(1-5)1014 cm-3 for N-atoms, (3-6)1010 cm-3 for N2(A), (1 1012– 5 1013 cm-3) for N2(X,v > 13) and 2 108 – 1010 cm-3 for N2+, depending on the x value of Ar-xN2 gas mixtures and of the gas pressure between 2 and 4 Torr. In RF afterglow a luminous jet is produced at 3 10-3 s after the plasma at 6 Torr in pure N2 with active species densities a little lower than in the HF diffuse afterglow .Outside this jet and at a long afterglow time (10-1s) , it is obtained diffuse RF afterglows without N2+ ions , with density about one order of magnitude lower than inside the jet. In RF afterglow , the O-atom density ratio was found to be only about 10-6 (1ppM) of the total N2 molecular density. In HF afterglow ,it was measured an O-impurity density more than two order of magnitude higher (150-400 ppM) than in RF (1 ppM). The high atom density in the HF afterglow could explain in part the active specie densities higher in HF than in RF , by a combined effect of increase of plasma electric field and decrease of active species destruction on a polluted tube wall.

Keywords
N2 HF and RF afterglows
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