39th European Physical Society Conference on Plasma Physics

16th International Congress on Plasma Physics

Stockholm, Sweden, 2-6 July 2012

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abstracts

Vol. 36F
ISBN 2-914771-79-7

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2 - 6 July 2012

Stockholm, Sweden

Editors:	S. Ratynskaya, L. Blomberg, A. Fasoli
Produced by:	B.Ph. van Milligen
Published by:	European Physical Society
Series editor:	Prof. O. Scholten, Groningen, The Netherlands
Managing editor:	P. Helfenstein, Mulhouse

List of conferences

Capacitively coupled rf plasmas in N_2-H_2 mixtures

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This paper studies the modifications induced in low-pressure radio-frequency (rf) capacitively coupled nitrogen plasmas, by the addition of a few amount of hydrogen (up to 5%). The work is of interest for material processing, such as the nitriding or the etching of low-k substrates, as well as in planetary studies, namely when N_2-CH_4 plasmas are adopted.

The plasmas are studied using both experiments and simulations. The experimental setup is a parallel-plate reactor (driven at 13.56 MHz frequency), surrounded by a cylindrical metallic grid to confine the discharge [1]. Electrical diagnostics allow measuring: (i) the electron density, by using a resonant cavity method; (ii) the effective rf power coupled to the plasma, by using the subtractive method [2]. Optical emission spectroscopy diagnostics are used to study the evolution, with the working conditions, of: (i) the First Negative System with the N_2^+ band; (ii) the atomic hydrogen H_β line at 486.1 nm; (iii) the atomic argon line at 811.5 nm (Ar is used here as an actinometer). Simulations use a hybrid code that couples a 2D (r, z) time-dependent fluid-type module, describing the transport of the charged particles, to a very complete 0D kinetic module, for the nitrogen-hydrogen mixture. Results reveal that the electron density increases with the amount of injected H_2, at constant coupled power.

References

[1] G. Alcouffe et al, Plasma Sources Sci. Technol. 19, 015008 (2010)
[2] L.L. Alves et al, Plasma Sources Sci. Technol. (submitted, 2012)

Acknowledgements

Work supported by a PICS Cooperation Program, financed by the Portuguese FCT and the French (CNRS). A. Mahjoub thanks the ANR program (ANR-09-JCJC-0038 contract) for a post-doctoral position.