TA014
PLASMA PROCESSING

APPLICATIONS OF HIGH PRESSURE PLASMA CHEMISTRY TO THE ABATEMENT OF PERFLUOROCOMPOUNDS FROM MICROELECTRONICS MANUFACTURING

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It is well known that exhaust gases from the manufacturing, transportation, and utility industries can contribute to ozone-induced smog and acid rain, as well as to the climate change by their potential global warming and atmospheric ozone depletion mechanisms.

In order to achieve compliance with future legislative limits intended to reduce air pollution, it is necessary to develop alternative abatement methods for a wide variety of harmful gaseous compounds. These compounds can contribute to the global warming effect both directly and indirectly. Direct effects occur when the gas itself is a greenhouse gas like water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Indirect radiative forcing occurs when chemical transformations of the original gas produce other greenhouse gases, when a gas influences the atmospheric lifetimes of other gases, and/or when a gas affects atmospheric processes that alter the radiative balance of the earth. Very powerful greenhouse gases that are not naturally occurring include *hydrofluorocarbons* (HFCs), *perfluorocarbons* (PFCs), and *sulfur hexafluoride* (SF_6), which are generated in a variety of industrial processes [1].

In the semiconductor industry, for example, PFCs are used extensively for plasma enhanced chemical vapor deposition (PECVD), plasma etching and plasma cleaning. In general, only a small portion of these gases is consumed during semiconductor fabrication, so the effluent stream from a particular process may contain relatively large quantities of environmentally harmful compounds. While the ideal solution to this problem would be to develop cleaner processing methods, or to recover and recycle unused process chemicals, achieving the zero emission goal sought by the semiconductor industry will probably require continued use of some form of post-treatment.

The present work describes the development and application of a non-thermal plasma system sustained by 2.45GHz frequency microwaves (MW) and operated at atmospheric pressure against a wide variety of pollutant molecules of interest to microelectronics industry. The technology has been tested on gas flows containing C_2F_6, CHF_3, NF_3, SF_6 and particularly CF_4 to illustrate its effectiveness. It was found that successful abatement is dependent on the total gas flow, the total power level and the concentration of CF_4. Destruction and removal efficiencies of CF_4 up to 99% have been achieved using 1.9 kW of microwave power.

REFERENCES

[1] Climate Change 2001: The Scientific Basis: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Eds J. T. Houghton, Y. Ding, D. J. Griggs, M. Noguer, P. J. Van der Linden, X. Dai, K. Maskell, C. A. Johnson) 2001, vol. 1 (Cambridge University Press, New York).