ELEMENTARY PROCESSES AT SOLID SURFACES IMMERSED IN LOW PRESSURE PLASMAS (EXTENDED ABSTRACT)

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Plasmas are being used for a wide and rapidly expanding variety of applications. These cover the entire range form very hot plasmas, which can be used to induce thermonuclear-fusion-reactions, to cold plasmas; which are used to deposit films, modify surfaces, or produce etching. Processes, which occur in a plasma, are often dominated by reactions which occur on the surrounding surfaces. Therefore, the thrust of this paper is to review the relationship between phenomena observed in a plasma and processes which are known to occur at solid surfaces. (A written review on the same subject has recently been completed by the author and preprints are available.)

Plasma environments are very complicated, and it is often quite difficult to define the important parameters. For example, the flux and energy of ions and electrons impinging upon a given surface and the types of neutral species and their concentrations in the gas phase are often unknown. A change in one experimental parameter often influences all of these variables and therefore plasma data is notoriously difficult to interpret. It has been our experience that the best technique for understanding reactions at surfaces in plasma environment is to simulate the plasma using well defined experiments conducted outside the plasma. The thrust of this presentation will be to relate this type of experiment to phenomena observed in plasmas.

A first approach to understanding a plasma-surface reaction is to determine the type of species present in the gas phase and then to determine whether or not these species react chemically at the surface under the environment present in the plasma. Three aspects of this problem will be reviewed in this paper. First, chemical reactions which require or are enhanced by ion and electron bombardment will be discussed. This type of reaction is believed to be important in a large variety of situations and will be illustrated with experimental results for the "Ar^+-XeF_2-Si" and the "electron-XeF_2-SiO_2" systems. The experimental results will also be used to interpret observations which have been obtained in fluorocarbon plasmas.

Secondly, the characteristics of chemical reactions between ions and a surface will be discussed using the N_2^+-tungsten system as an example. The experimental results will be used to interpret observations which have been obtained in a nitrogen-argon glow discharge.

Thirdly, the interaction of neutral particles (radicals and ground state molecules) with surfaces will be discussed. It will be shown that a knowledge as to whether or not a given molecule chemisorbs on a given surface is useful in interpreting data in both fluorocarbon and nitrogen-argon discharges.