Some Novel Diagnostic Techniques for Plasma Chemistry

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In order to probe the mechanisms of chemical transformations in electric discharges it is most useful to monitor concentrations of reactants, products and reactive intermediates as a function of discharge parameters. Mass spectrometry, a popular technique for observing intermediates in chemical reactions, meets with particular difficulty when applied to discharges, due to the presence of excited molecules as well as free radicals in such systems. Molecular beam analysis, a synthesis of mass spectrometry with molecular beam measurements of electric and magnetic moments and velocity distributions, is a technique developed in our laboratory which offers distinct advantages for the analysis of intermediates in electric discharges.

In low pressure discharges, end product anylysis can be facilitated by sample compression. A chromatographc sampling system which employs compression in order to achieve high sensitivity has been developed and evaluated.

There is some question concerning the appropriate discharge parameters to be employed in correlating measured variations in concentrations. We are investigating the use of discharge "actinometers" as a means of measuring the intensity of electric discharges. In discharges the intensity (number and energy of the electrons) and the chemistry are strongly coupled. Thus, it is necessary that the actinometer be present in the reactor; it is not permissible to substitute vessels as is customary in photochemical investigations. Since the actinometer is to measure only the discharge intensity, it must not participate in any chemical reactions with molecules and intermediates in the discharge. A number of compounds have been evaluated as possible choices for discharge actinometers.

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