Mass-Spectromic Sampling of the Ionic and Neutral Species Present in Different Regions of an RF Discharge in Methane

M. J. Vasile and G. Smolinsky

The ionic and neutral products of RF discharges in methane produced by capacitive and inductive coupling have been examined. The configurations studied were (1) axial sampling through an internal RF capacitor electrode, (2) axial sampling through an electrically grounded internal capacitor electrode, (3) radial sampling of a capacitively coupled discharge through an electrically floating electrode, and (4) axial sampling of an inductively coupled discharge through a grounded electrode. Major differences in the ions observed occur between configurations (1) and (3), above. In the former, the dominant ions found are C^+, CH^+, CH_2^+, CH_3^+, $C_2H_2^+$, and $C_2H_3^+$, with very little abundance of ions containing more than three carbon atoms. In the latter, the ions CH_3^+, CH_5^+, $C_2H_3^+$, and $C_2H_5^+$ are dominant, with a significant fraction of the total comprising C_4 to C_6 ions. The dissimilarity observed between these two cases clearly can be attributed to the difference in energy of the electrons which cause the ionization and the difference in kinetic energy of the primary ions which undergo ion-molecule reactions to yield secondary ions. Ions containing two or more carbon atoms have been shown to result from ion-molecule reactions rather than from primary ionization of C_2 neutrals. The neutral gas composition is also a function of position in the discharge and is clearly related to the energy available at any particular sampling point.

Prof. G. Smolinsky
Bell Laboratories
Murray Hill, New Jersey 07974
USA