Electron-initiated photochemistry: Molecular ionization, excitation, and reactions

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Photochemistry is excited-state chemistry where the excited state is prepared by absorbing a photon. Another way to prepare an excited state is impact by a particle. In solution, an incident electron is more likely to strike a solvent molecule than any dilute solute. This is classical pulse radiolysis, in which reactive species are created by destroying solvent molecules. In the gas phase, electron impact on molecules may result in attachment (negative ion), ejection of a secondary electron (ionization), or excitation. Each of these possibilities can lead to chemical reactions, which is what makes plasma chemistry complex and technologically useful. Besides plasma chemistry, another application is electron-ionization mass spectrometry. Mass spectrometry is one of the basic tools of analytical chemistry, yet has evaded a useful theoretical description. This contrasts with photon spectroscopies, for which useful theoretical predictions are routine. I will give an overview of the molecular processes involved in electron-ionization mass spectrometry, making connections with photochemistry. I will also provide one or two examples of catalysis from the broader field of gas-phase ion chemistry.

COMP 478: Electron-initiated photochemistry: Molecular ionization, excitation, and reactions

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