RESOLV iGSS Summer School 2024. Advanced Hands-On Module:

Ionization of water ice with a high-energy electron source

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The intermediates formed by ionizing radiation are highly reactive, making it impossible to investigate their structure and properties directly. To overcome this obstacle, a low-temperature stabilization technique is employed, which prolongs the lifetime of such species enough to study them with standard spectroscopic techniques. The general approach is to stabilize particles in a rigid medium at cryogenic temperatures.[1]

The physics and chemistry associated with the irradiation of condensed phases by ionizing radiation (e.g., ions, electrons, and energetic photons) are of considerable practical and fundamental interest. Photolysis and radiolysis of water vapor, aqueous solutions, and thin films of H_2O have been thoroughly investigated[2] in relation to their importance in radiation biology, medicine, and nuclear technology. Solid water is also highly abundant in astrophysical environments, such as icy mantles coating interstellar dust grains, and in icy bodies such as comets and moons, where exposure to ionizing radiation is significant.[3,4] In this module, we will use an electron source to irradiate water ice, starting with low-energy electrons (200 eV) and finishing with high-energy electrons (5 keV). To follow these processes and observe the formation of new products, such as solvated electrons[5] and hydrogen peroxide[6], we will use FT-IR and UV-Vis spectroscopy.

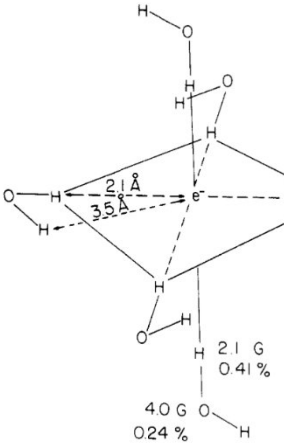

Figure 1: Geometrical structure of the solvated electron in aqueous glasses.[5]

As a result, you will learn:

- how to record and analyze UV/Vis spectra of irradiated water ice
- how to work with a high-energy electron source
- how to work with high vacuum systems
- more about radiation chemistry of water and solutions

Literature

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