Investigations into the Astrochemistry of H_2O_2, O_2, and O_3 in Ion-Irradiated Ices

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Abstract

Features due to solid-phase H_2O_2, O_2, and O_3 have been found in the reflectance spectra of some of the icy satellites of Jupiter and Saturn (Spencer and Calvin, 2002; Noll *et al.*, 1997; Carlson *et al.*, 1999). These molecules can form by high-energy jovian magnetospheric and cosmic radiations bombarding the H_2O-ice on the surfaces of these worlds. This radiation breaks chemical bonds in the ice, forming species that can react to produce new molecules. Gravitational loss of H_2 then leaves an oxygen-richer ice containing H_2O_2, O_2, and O_3. The radiation chemistries of these three molecules are linked since H_2O_2 is a proposed precursor for O_2 formation, and O_2 is itself a precursor for O_3.

In the Cosmic Ice Laboratory at NASA-Goddard we have studied these processes by using a 0.8 MeV protons to bombard H_2O-ices (Moore and Hudson, 2000) containing H_2O_2, O_2, and O_3. We are able to measure rates of molecular formation and destruction, and IR spectra as a function of temperature, sample concentration, and radiation dose. In this presentation we show some of our most-recent results on the radiation chemistries of H_2O, H_2O_2, O_2, and O_3, such as the formation of the HO_3 radical in irradiated H_2O + O_3 ices. Since O_2 is now known to be an interstellar molecule (Liseau *et al.*, 2006), our results may also apply to the chemistry of icy interstellar grain mantles.

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