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Laboratory Spectroscopy of Ices of Astrophysical Interest

M. H. Moore (1), R. L. Hudson (2)
(1) USRA/NASA Goddard Space Flight Center, Greenbelt, MD USA (marla.h.moore@nasa.gov / Fax: 301-286-0440), (2) NASA Goddard Space Flight Center, Greenbelt, MD USA

Abstract

Ongoing and future NASA and ESA astronomy missions need detailed information on the spectra of a variety of molecular ices to help establish the identity and abundances of molecules observed in astronomical data. Examples of condensed-phase molecules already detected on cold surfaces include H_2O, CO, CO_2, N_2, NH_3, CH_4, SO_2, O_2, and O_3. In addition, strong evidence exists for the solid-phase nitriles HCN, HC_3N, and C_2N_2 in Titan's atmosphere. The wavelength region over which these identifications have been made is roughly 0.5 to 100 μm. Searches for additional features of complex carbon-containing species are in progress. Existing and future observations often impose special requirements on the information that comes from the laboratory. For example, the measurement of spectra, determination of integrated band strengths, and extraction of complex refractive indices of ices (and icy mixtures) in both amorphous and crystalline phases at relevant temperatures are all important tasks. In addition, the determination of the index of refraction of amorphous and crystalline ices in the visible region is essential for the extraction of infrared optical constants. Similarly, the measurement of spectra of ions and molecules embedded in relevant ices is important. This laboratory review will examine some of the existing experimental work and capabilities in these areas along with what more may be needed to meet current and future NASA and ESA planetary needs.

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