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TITLE: The formation, destruction and chemical influence of water ice: a review of recent laboratory results

ABSTRACT BODY:

Abstract Body: Water ice is ubiquitous in dense molecular clouds, the stellar nurseries of the Galaxy. Recent theoretical investigations (Cleeves et al. 2014) suggest that much of this pre-stellar ice survives disk formation and thus takes part in forming of planets and planetesimals. Interstellar and circumstellar ice abundances thus affect the compositions of planets. The presence of water ice is also important for the formation of other molecules on grains. Water is the most abundant ice constituent and therefore sets the ice diffusion environment, which regulates for example the organic photochemistry proposed to drive the complex chemical evolution during star formation.

The processes that regulate the formation, destruction and chemical influence of water have all been explored in laboratory experiments. One of the most significant advances in recent years is the arrival of laboratory experiments on hydrogen additions to condensed O, O_2 and O_3 — the proposed main formation pathways of water ice. These experiments have revealed how the interplay between diffusion and reaction barriers together regulate the water formation chemistry as well as the chemistry of closely related carbon-bearing species such as CO_2. A very different set of laboratory experiments have in the same time period constrained the efficiency of non-thermal water desorption, especially UV-induced ice photodesorption. Laboratory work on other non-thermal desorption pathways, e.g. chemical desorption, has also advanced, though more experiments are needed to quantify the importance of these desorption pathways relative to photodesorption. There are also an increasing number of experiments aimed at constraining the diffusion environment of water-dominated ices and its effects on the formation of organics when ice mixtures are exposed to UV photons or other kinds of energetic radiation.

I will review the many significant laboratory water ice experiments that has been relaized in the past few years and how they are affecting our understanding of interstellar and circumstellar water abundances and distributions, and their chemical importance.

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