Direct measurement of desorbed species following the photolysis of amorphous solid water by REMPI technique

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Water exists as snow in the cold regions on the earth, as ice particles such as ice clouds in the upper atmosphere, and as interstellar ice dusts in the universe. The photochemical reactions in snow or on ice particles induce environmental atmospheric reactions and astrochemical reactions. Atmospheric reactions in the polar regions, ozone depletion in the high altitude of atmosphere, creation of life on the earth, all these phenomena are related to the photochemical reactions in snow and on ice surfaces.

In the condensed phase photolysis of amorphous solid water (ASW), OH, H_2O_2, and HO_2 have been identified at 10 K, and they are the primary and secondary photoproducts. (Reference: P. A. Gerakines, W. A. Schutte, and P. Ehrenfreund, Astron. Astrophys. 312, 289 (1996).).

When water ice is photoirradiated with ultraviolet light, two primary photodissociation reactions (1) H + OH and (2) H_2 + O, and (3) H_2O photodesorption reaction can occur.

However, reactions (2) and (3) have not directly confirmed yet in the condensed phase photolysis, and not only the primary unimolecular reactions but also the secondary reactions would be the sources of photoproducts.

In addition, the internal energy distribution is a key parameter for all interstellar chemistry because hot species enable chemical reactions that are not possible when the species are in their ground states. To understand photolysis of ASW comprehensively, it is crucial to reveal the energy partitioning in the reaction products and the contribution of secondary photoproducts.

In the present study, using pulsed 157 nm laser radiation various desorption species (H, H_2, O, OH and H_2O) from ASW have been directly confirmed by resonance-enhanced multiphoton ionization (REMPI) technique (See Figure.).

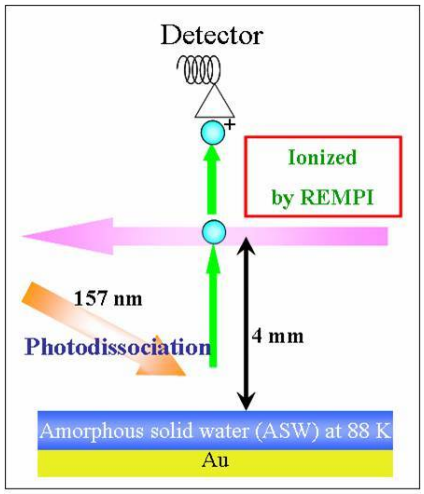

Figure: Image of REMPI experiment