

## Formation of H<sub>2</sub>O and its isotopologues on interstellar grains

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Solid H<sub>2</sub>O is the most abundant component in icy grain mantles in molecular clouds. Since the observed abundance of solid H<sub>2</sub>O in molecular clouds cannot be explained only by gas-phase synthesis, it has been considered that solid H<sub>2</sub>O is produced on the surface of interstellar grains. Tielens and Hagen (1982) proposed that solid H<sub>2</sub>O is produced by hydrogenation of O, O<sub>2</sub>, or O<sub>3</sub>. Since then, the formation of H<sub>2</sub>O through those reactions has been experimentally demonstrated to occur by several research groups (e.g. Miyauchi et al. 2008; Ioppolo et al. 2008).

In addition to these hydrogenation processes, reactions of hydroxyl radicals (OH) with H<sub>2</sub> have been accepted as an important route to H<sub>2</sub>O formation in dense molecular clouds where the UV field is very weak. Under those conditions, it is unlikely that the reaction thermally occurs due to the significant barrier of about 2000 K; the reaction should proceed through quantum tunneling if it really occurs in dense clouds. However, it has not been experimentally demonstrated so far.

In this presentation, we will show experimental results on the formation of H<sub>2</sub>O and its isotopologues (HDO and D<sub>2</sub>O) by the reaction of OH/OD with H<sub>2</sub>/HD/D<sub>2</sub> at 10 K, and discuss its astrophysical implications.

Keywords: water, deuterium enrichment, molecular cloud, surface reaction, tunneling reaction, isotope effect