UV photodesorption of intact molecules and of photofragments from solid formaledhyde and methanol

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The photodesorption, i.e. the desorption of molecules induced by the UV photoprocessing of the molecular icy mantles of grains, is often considered as an important non-thermal process for explaining the gaseous molecular abundances in some of the coldest regions of the ISM (disks, edges of clouds...). Past experimental studies of the photodesorption process have given many results for several simple ices (CO, H₂O, CH₃OH, CO₂...). However, for some cases, the absolute photodesorption rates varied from a study to another. For some others, the rates were found surprisingly constant at about 10⁻³-10⁻⁴ molecules/photon for a collection of condensed species, whose properties are significantly different (adsorption energies, UV absorption cross sections, mass, dissociative behaviors...).

Conducting energy-resolved experiments at the synchrotron SOLEIL, we have these last years focused our studies on UV photodesorption in the 7 - 13.6 eV range, and obtained for the first time energy-resolved photodesorption rates for a collection of small molecules such as CO, N₂, O₂ and CO₂ [e.g. 1-3]. Recently, we have focused our photodesorption studies on condensed methanol CH₃OH and formaldehyde H₂CO, which are both organics detected in the gas phase of the cold ISM.

Our recent results on the photodesorption of methanol and formaldehyde will be presented. The predominant role of the UV-photochemistry in the solid organics will be emphasized. For the H₂CO ices, this photochemistry promotes the intact molecule desorption by the production of excited CO fragments in the solid phase [4]. On the contrary, the photodissociation of solid methanol prevents its photodesorption as an intact molecule, which has been found very low as compared to what was previously considered. Instead, the photoprocessing is dominated by the desorption of its direct photofragments such as CH₃, OH, H₂CO, H₃CO and CO [5], therefore enriching the gas phase in reactive radicals.

References