Understanding VUV Photon Stimulated Desorption Mechanisms from Simple Molecular Condensates

J.-H. Fillion.[1], *R. Dupuy*[1], *R. Basalgète*[1], *G. Féraud*[1], *C. Romanzin*[2], *P. Marie-Jeanne*[1], *P. Jeseck*[1], *V. Baglin*[3], *R. Cimino*[4], *X. Michaut*[1], *M. Bertin*[1]

[1]Sorbonne Université, Observatoire de Paris, Université PSL, CNRS, LERMA, F-75252, Paris, France
[2]Institut de Chimie Physique, UMR8000 CNRS, Université Paris-Saclay, 91405 Orsay, France
[3]CERN, CH-1211 Geneva 23, Switzerland
[4]Laboratori Nazionali di Frascati (LNF)-INFN, I-00044 Frascati, Italy
jean-hugues.fillion@sorbonne-universite.fr

Photon Stimulated Desorption (PSD) processes play a key role in the exchanges between the gas phase and the icy solid phase of cold regions of the interstellar medium, where a lot of molecules are expected to freeze out on dust grains. In these regions, the grain temperature is so low (<30 K) that thermal desorption can be completetly neglected. PSD have been used to explain otherwise puzzling gas phase observations of simple molecules like CO in dense cores or cold H_2O in outer parts of protoplanetary disks. Similarly, photon-induced desorption of residual molecules adsorbed on the cryogenic parts of accelerators such as the LHC can be a limiting factor for their vacuum performances. Understanding the desorption mechanisms from simple condensates is of particular interest in these two contexts.

I will present experimental PSD results obtained from condensed films of molecules of astrophysical interest at cryogenic temperatures. The case of CO photodesorption at 15 K, for which an indirect desorption mechanism has been clearly evidenced using tunable synchrotron radiation (SOLEIL, France) [1], will be first discussed. Recent experimental results obtained using a pulsed VUV laser beam (figure 1) challenges the picture provided by previous molecular dynamics simulations. PSD from solid water, as major component of interstellar ices, will be also presented. Its PSD is basically very different from that of CO. Several photodesorption mechanisms have been evidenced in this case: (1) intact water desorption giving rise to a strong isotopic effect [2] (2) indirect desorption in binary ices due to "kick-out" by collision with atoms (H/D) produced by water photodissociation [3].

These two examples illustrate that a wide variety of mechanisms can be at play in a real multi-component interstellar condensate or on cold metal surfaces in vacuum pipeline.

Index Terms: indirect photodesorption, chemically induced desorption, collision induced desorption.

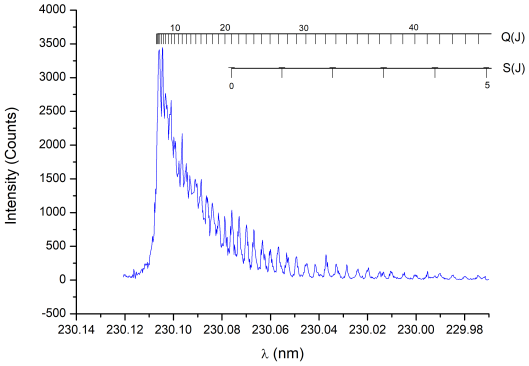

Figure 1: *(2+1) B* $^1\Sigma^+(v'=0) - X^1\Sigma^+(v"=0)$ *REMPI spectrum of* ^{12}*CO following the photon-stimulated desorption at 157 nm from a 60 ML CO film (15 K). The spectrum shows a few rotational excitation of the desorbing molecules (up to J=40 rotational lines are observed.*

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