Non-Thermal Desorption of Large PAHs from Interstellar Ice Analogues

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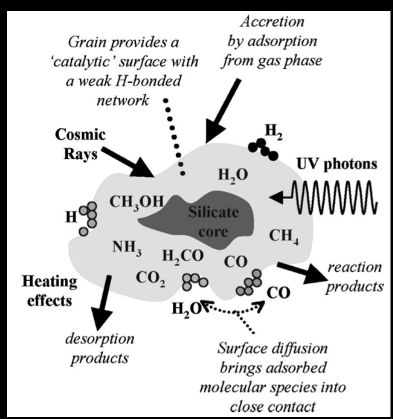
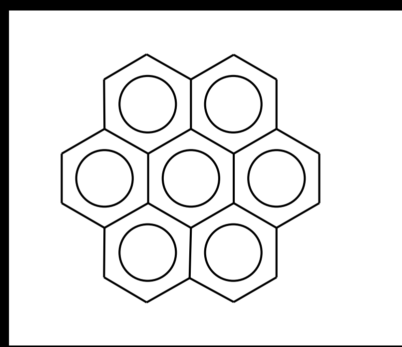
Statement of the Problem

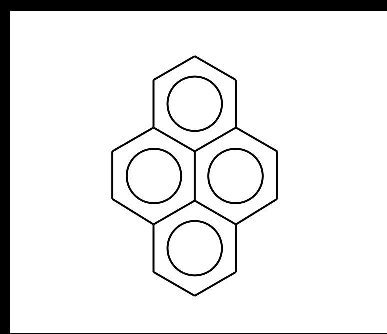
PAHs are the largest molecules known in space and contain about 10-20% of the total available cosmic carbon. They have been found in objects, such as meteorites, and in interplanetary dust particles, indicating their presence in the early stages of the formation of our solar system. Moreover certain infrared emission features are consistent with highly vibrationally excited PAHs. They may play an important role in the formation and evolution of life on Earth [Bernstein et al. 1999, Ehrenfreud et al. 2006].
Water is by far the dominant component of interstellar ice. Since PAHs are considered to be widespread throughout the ISM, they are likely to be frozen out wherever H_2O-rich ices are present. Interstellar ices can desorb with UV light and cosmic rays. The work of J. Thrower et al. (The Astrophysical Journal, **673**, 1233-1239, 2008) showed that UV long wavelength (longer than 200 nm) can induce C_6H_6 on water to desorb via a number of efficient mechanisms (mediated by benzene), but also low energy electrons can be responsible for that, although by a different way (mediated by H_2O).

Illustration of the make up of an icy dust grain in the ISM and the typical energetic processes to which it is exposed.
(Picture taken from McCoustra et al., Rev. Sci. Instrum., **73**, 2161-2170, 2002)





CORONENE
($C_{24}H_{12}$)



PYRENE
($C_{16}H_{10}$)

Project

Our purpose is to perform desorption experiments of larger PAHs, such as pyrene and coronene from water, in order to have a deeper insight on these systems in comparison with what is already known when using a model molecule like benzene.
There are two classes of experiments:

Electron stimulated desorption

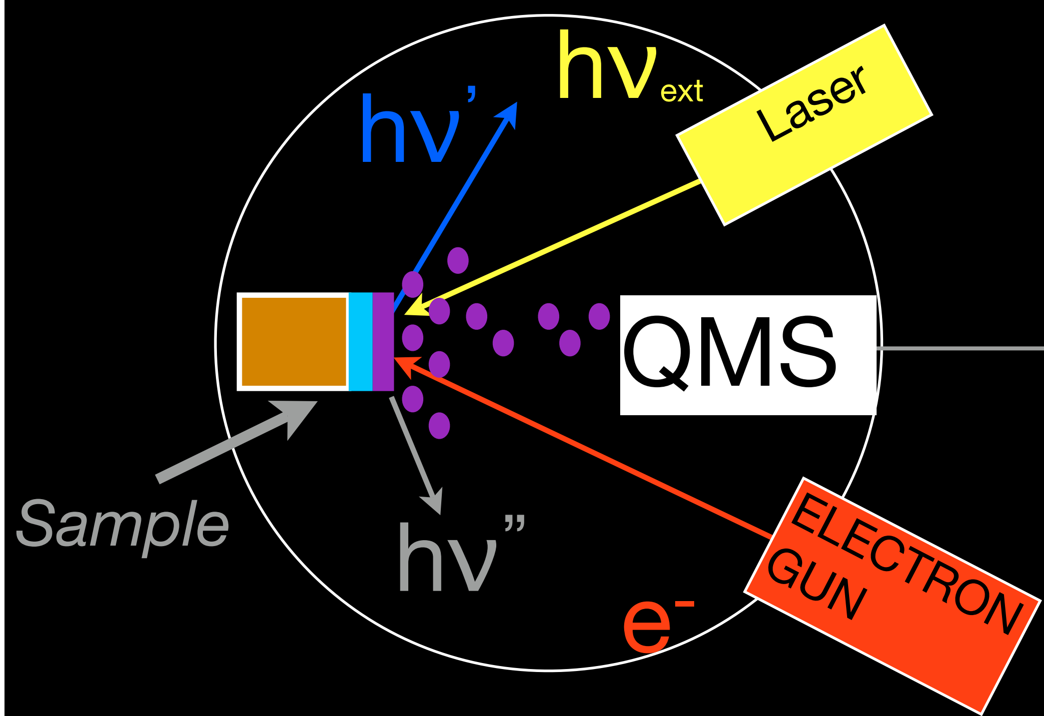
- Rate of the process
- Role of H_2O and hydrogen bonding in transfer excitation
- Luminescence

Photostimulated desorption

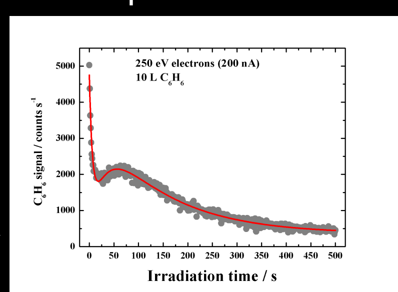
- Rate of the process and dynamics
- The effect of longer wavelength on photostimulated desorption.
- Luminescence.

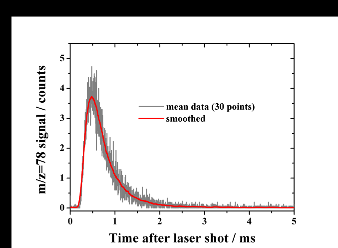
Schematic of the experimental set up.

Spectra taken from J. Thrower (PhD. Thesis, Heriot-Watt University, 2010).



Desorption kinetics





Desorption dynamics

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