AstroSurf 2007
Heriot Watt University

The AstroSurf conference was held from the 13th to the 15th June 2007 and brought together the fields of surface science and astronomy. Talks and posters covered laboratory, observational and theoretical studies of the chemistry on grain surfaces in the ISM. I present a summary of some of the talks I found most interesting.

Herbig Haro Objects
William Whyatt

Herbig Haro objects are formed when bipolar outflows of gas ejected by young stars collide with the less dense clouds of nearby gas and dust at speeds of several hundred kilometres per second. This produces bow shocks. Molecular condensations have been found ahead of HH objects by several groups over 20 years. These clumps are seen in enhanced emission from certain molecular species, particularly HCO^+ and NH_3. Because the bipolar jets travel, these clumps are transient. Clumps cannot be resolved unless they are illuminated by a UV source such as the HH object. It is therefore unknown if they pre-date the HH object.
A large-scale search was made for clumps ahead of HH objects. Dynamically affected material was avoided by observing at the end of the jet and the sample was limited to HH objects in dark clouds. Where possible the sample contained only one HH object per region. Northern and southern hemisphere sources were studied using the JCMT in Hawaii and SEST in Chile. The J=3-2 line of HCO^+ was observed in 21 sources, 11 of which showed emission. The high column density of HCO^+ observed indicated the presence of clumps. If the whole region had this column density, the cloud would have different properties. The next steps in this project are to extend the observations of the clumps and model them using the UCL-PDR code.

Desorption of Hot Molecules From Photon Irradiated Interstellar Ices
John Thrower

Polycyclic aromatic hydrocarbons (PAHs) are planar aromatic carbon networks whose stability suggests survival in the ISM. They are a major sink for carbon in the ISM and may be the origin of unidentified IR emission bands and diffuse interstellar bands. Large PAHs may form part of the carbonaceous grain core population, the 217nm "bump" feature in the interstellar extinction curve. There is a need to explore the fundamental processes that occur when UV radiation interacts with PAHs in a water ice dominated environment. The photoprocessing of benzene/water layered systems has been studied.
The experiment used a sapphire substrate at a temperature of around 80K and a pressure of less than $2x10^{-10}$ mbar. The photon-induced desorption of both water and benzene was monitored using time-of-flight mass spectrometry (TOF-MS) and line of sight mass spectrometry (LOS-MS). In layered systems it was found that less benzene desorbed when it had to diffuse through water. Water desorption was enhanced in the presence of benzene

due to the energy transfer from benzene to water. Benzene was found to come off "hot" with a translational temperature of more than 1000K. These "hot" molecules are likely to play an important role in the chemistry of the low temperature environment of the ISM. In future work, electron stimulated processes will be investigated, along with a study of any photochemistry that is initiated.

Could Interstellar Molecular Hydrogen Form on PAHs?
Liv Hornekaer

The most abundant molecule in the ISM, H_2, is found in a wide range of physical conditions. It is observed in the interior of cold dense molecular clouds, diffuse interstellar clouds, PDRs and post shock gas. Molecular hydrogen formation is believed to be a grain-surface reaction, as no efficient route exists for its formation in the gas phase. The grain size is important as small grains undergo significant temperature fluctuations, which affects the lifetime of H atoms on the grain surface. An effective grain size for H_2 formation is typically around 100nm. Polycyclic aromatic hydrocarbons (PAHs) are an intermediate size, between very small grains and large molecules. They are believed to be ubiquitous in the ISM. Recent Density Functional Theory calculations show that H_2 formation on PAHs could be a viable molecular hydrogen formation route under select interstellar conditions.

Laboratory Studies of Water / Methanol / Carbon Monoxide Ice Mixtures
Simon Green

Water is the dominant component of ice mantles on interstellar dust grains. Methanol is also present and there is a large abundance of carbon monoxide in both gas and solid phases.
Previous experiments have shown that trapping of CO in water pores occurs when a mixed ice of porous amorphous solid water and carbon monoxide is formed. This means that CO is retained on the grain at higher temperatures than expected. Methanol / carbon monoxide ice mixtures have shown similar results.
This study investigates the three-component $H_2O/CH_3OH/CO$ ice system to determine the effect of the mixed polar layer on CO trapping. The experiment was carried out in a UHV chamber at a pressure of around 10^{-10} mbar and a temperature of around 10K. Temperature programmed desorption (TPD) was carried out. Water was found to desorb between 150K and 180K but methanol desorbed between 100K and 150K. This means that water and methanol do not co-desorb.
The next steps in this work are to carry out Reflection-Absorption Infrared Spectroscopy (RAIRS) on this system and construct a kinetic model with CKS.

Conclusions

It is clear that collaboration between laboratory, observational and theoretical surface scientists is important in making progress towards understanding the chemistry of the ISM and how it affects the evolution objects such as molecular clouds.

Alison Craigon 20/6/2007