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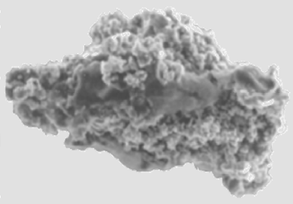
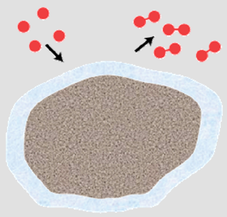
The interaction between polycyclic aromatic hydrocarbons (PAHs) and hydrogen atoms is being investigated using a combination of various surface science techniques. The results are providing valuable insights into the role played by these molecules in interstellar H_2 formation

Project Outline

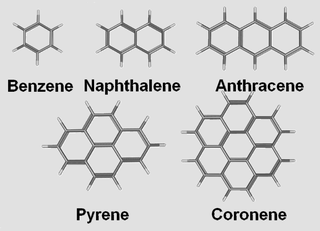
Investigating the role of PAHs in H_2 formation



Molecular hydrogen H_2 is the most abundant molecule in the interstellar medium (ISM). Reactions on grain surfaces are thought to play an important role in the formation of H_2 and other important molecules. However, in many regions of the ISM, such processes remain poorly understood.



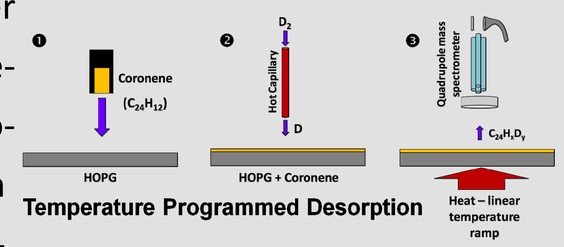
Polycyclic aromatic hydrocarbons account for up to 20% of interstellar carbon. It has been proposed that they may play a crucial role in H_2 formation in some regions.

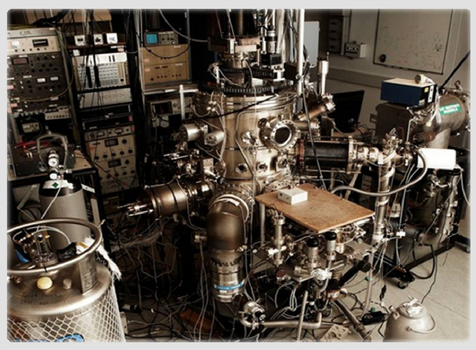


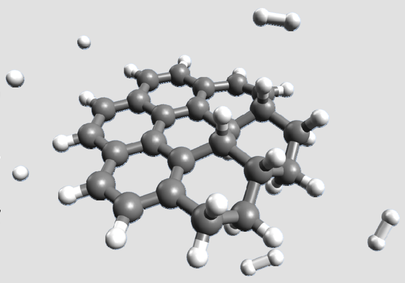
This project aims to investigate the potential role played by PAH molecules in the surface mediated formation of key interstellar species, in particular H_2.

Research Achievements

The interaction between PAHs and atomic hydrogen has been investigated by exposing a monolayer of coronene to a beam of deuterium atoms. Temperature programmed desorption has been used to probe the reaction products and reveals the formation of superhydrogenated coronene species. The observed H/D exchange provides evidence for abstraction reactions that lead to the formation of HD and H_2. This work has been reported in two publications (see below).







Experiments have revealed the formation of highly superhydrogenated PAH molecules and provided evidence for a catalytic role in H_2 formation.

Research Objectives

- Wp.2.01 Molecular desorption. Investigate the interaction of PAH molecules with carbonaceous interstellar grains.
- Wp.3.01 Atom irradiation. Experimentally confirm the formation of superhydrogenated PAHs following exposure of PAHs to atomic hydrogen as indicated by previous density functional theory calculations.
- Wp.1.03 Rate of molecule formation & 4.04 H_2 formation. Examine the role played by superhydrogenated PAH species in interstellar H_2 formation through abstraction reactions.
- Wp.3.06 Atom bombardment-induced chemical transformations. Perform measurements to probe the impact of hydrogenation on the electronic spectra of PAH molecules as a possible observational aid.
- Wp.1.02 Release of reaction energy & 2.02 Photodesorption. Investigate the interaction of superhydrogenated PAH species with ultraviolet photons as a possible mechanism for H_2 ejection.
- Wp.3.05 Photon induced chemical transformations. Proposal submitted in collaboration with colleagues at HWU and MU to investigate XUV induced physical and chemical processes in PAH containing low temperature ices using the FLASH facility in Hamburg

Training Objectives & Achievements

Research training

- Development of skills in using ultrahigh vacuum and surface science techniques.
- Introduction to scanning tunneling microscopy (STM).
- Research secondment in the Sackler laboratory for astrophysics at Leiden observatory. Training in use of optical spectroscopic techniques.
- Future planned collaborations with researchers at Leiden to investigate hydrogen atom irradiation of benzene.
- Collaboration outside of LASSIE with group of Vito Mennella, Naples.
- Publications:
  - J. Thrower *et al.*, 2011, EAS Publications Series, **46**, 453. ; V. Menella *et al.*, submitted.
- Oral and poster contributions at several international conferences.
- Lecture course on astrochemistry held at Leiden Observatory.
- Broaden knowledge of the field of Astrochemistry through LASSIE organised and other events.
- Organised 2010 Young Researchers in Astrochemistry meeting held at UCL

Supplementary skills training

- Two day course on writing grant proposals.
- Presentation skills.
- Course on public outreach activities.
- Project and team management.
- Day to day supervision of PhD, masters and bachelor students.
- Involvement in ”Stars R Us” public outreach event during Edinburgh International Science Festival 2010.

Opportunities

This project provides a range of valuable opportunities to develop my skills as a researcher. In particular it has enabled me to broaden my knowledge of the field of astrochemistry through attendance at scientific conferences and training events organised both within and outside of the LASSIE training network. The research being performed has allowed me to consolidate and expand my knowledge of various surface science techniques and their application in surface astrochemistry.

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