Probing the formation of PAH interstellar dust grains

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Synopsis The first solvation shell of coronene clusters solvated by helium atoms or hydrogen molecules was analyzed to obtain informations about the most conformational patterns.

The infrared emission lines commonly observed in various astronomical sources, such as planetary nebulae, edges of ionized regions or around young stars can be associated to polycyclic aromatic hydrocarbons (PAH's). These organic molecules are very common in the universe [1] and can aggregate to form soot-like particles or dust grains in interstellar clouds. The reaction pathways that occur on the surface of dust grains can be used to explain the abundances of many species in the interstellar medium (ISM) [2].

Superfluid helium nanodroplets (HND) can be used to recreate the conditions of the ISM, mainly due to their special properties to pick up virtually any atom or molecule that collides with them and cool them down to 0.4 K [3], making these cryogenic matrix a perfect laboratory to simulate this conditions where PAH aggregation takes place.

In order to study the conformational aspects of a dust grain, a new mass spectrometric method was implemented. HNDs were first doped by individual pickup with coronene molecules and subsequently with Helium atoms or hydrogen molecules. The neutral doped droplets were then ionized by electron bombardment and analyzed by a reflectron time-of-flight mass spectrometer. By investigating the behavior of the first He or H_2 solvation shell, it is possible to obtain information concerning the packing of the PAHs. Anomalies in the intensity of the mass spectra peaks, known as magic numbers, are used to identify the most likely aggregation patterns of the PAH molecules.

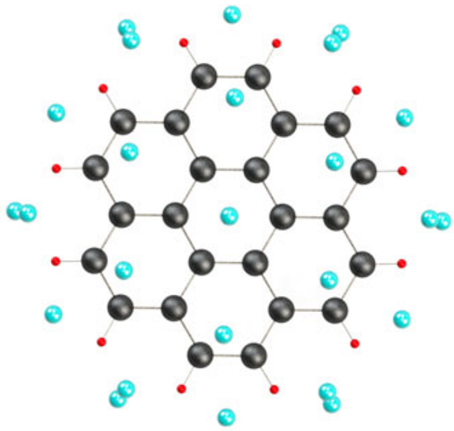

Figure 1. Graphical representation of a coronene molecule solvated by He atoms.

References

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