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Fragmentation and molecular growth of polycyclic aromatic hydrocarbons in the interstellar medium

Tao Chen[1,2]

[1]Leiden University, Leiden Observatory, Niels Bohrweg 2, NL-2333 CA Leiden, Netherlands
[2]School of Engineering Sciences in Chemistry, Biotechnology and Health, Department of Theoretical Chemistry & Biology, Royal Institute of Technology, 10691, Stockholm, Sweden
email: chen@strw.leidenuniv.nl

The interstellar medium (ISM) can be considered a molecular factory, in which a rich organic inventory has been identified through radio and infrared observations (Tielens 2008). This work review the recent experimental and theoretical studies on fragmentation and molecular growth of polycyclic aromatic hydrocarbon molecules in the ISM.

The gas-phase molecules can be ionized, isomerized, dissociated following the impacts of ions, atoms, or photons (Chen *et al.* 2014; Stockett *et al.* 2014, 2015; Zhen *et al.* 2016). Two types of fragmentation processes are found: statistical and non-statistical fragmentations. In statistical fragmentation processes, the losses of $C_{2n}H_x$ dominate the mass spectra (Chen *et al.* 2015). Non-statistical fragmentations represent direct knock-out of atoms from a molecule, in which single C-losses are commonly observed on the mass spectra (Stockett *et al.* 2014). The fragmentation of molecules lead to the formation of small molecules or isomerize to more stable structure, such as C_{60} or C_{70} (Zhen *et al.* 2014). On the other hand, small molecules may conglomerate a weakly bonded cluster, and form large molecules in the cluster following statistical or non-statistical fragmentations (Zettergren *et al.* 2013; Delaunay *et al.* 2015; Zhen *et al.* 2018). New molecules can be formed in such cycle, e.g., a bowl-shape molecule can be formed in the photodissociation experiement of bisanthenequinone cations (Chen *et al.* 2017), dumbbell C_{118} and C_{119} are formed inside clusters of C_{60} by collision with α particles (Zettergren *et al.* 2013), etc. These reactions enrich the molecular inventory in the ISM and may act as the first step towards life.

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