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A brief note on astrochemistry

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DESCRIPTION

Astrochemistry and molecular astrophysics are often used as synonyms to define an interdisciplinary field that involves chemistry and astronomy, (astro) physics, as well as a "flavor" of biology and geology. Even if it is difficult to define an unique goal, it can be surely affirmed that the main aim is to understand the chemical evolution occurring in space: from diatomics to molecules of a certain degree of complexity and beyond (Giovanni, 2011). In other words, this research area studies how molecules are formed and destroyed in different astronomical environments as well as how they interact with radiation.

Solar-driven hydrogen peroxide (H_2O_2) production presents unique merits of sustainability and environmental friendliness. Herein, efficient solar-driven H_2O_2 production through dioxygen reduction is achieved by employing polymeric carbon nitride framework with sodium cyanaminate moiety, affording a H_2O_2 production rate of 18.7 μmol h^{-1} mg^{-1} and an apparent quantum yield of 27.6% at 380 nm (B.R. Rowe, 1992).The overall photocatalytic transformation process is systematically analyzed, and some previously unknown structural features and interactions are substantiated via experimental and theoretical methods. The structural features of cyanamino group and pyridinic nitrogen- coordinated soidum in the framework promote photon absorption, alter the energy landscape of the framework and improve charge separation efficiency, enhance surface adsorption of dioxygen, and create selective 2^{e-} oxygen reduction reaction surface-active sites. Particularly, an electronic coupling interaction between O_2 and surface, which boosts the population and prolongs the lifetime of the active shallow-trapped electrons, is experimentally substantiated.

As is well-known, most of the matter-energy content of the Universe is composed of dark energy and dark matter. Indeed, atoms and molecules contribute <5% of the total. Focusing on atomic elements, the contribution of hydrogen and helium amounts to about 98%; therefore, that of heavier elements (such as carbon, nitrogen, and oxygen) is only about 2%. Nevertheless, this small fraction of heavy elements makes possible a great variety of chemical compounds. In the disk of our Galaxy (the Milky Way), about 90% of the atomic/molecular mass is in stars, and the remaining is in the interstellar matter, mainly in the form of clouds. These consist of gas and tiny dust particles and are the components out of which new stars and planets are born.

At the time of the discovery of interstellar gas and dust, it has thought that the extreme conditions (temperatures ranging between 10 and 106 K and densities from 10^{-4} to 108 particles/cm^3) of the interstellar medium (ISM) would only allow the presence of atoms. In the early forties, however, McKellar identified spectral lines attributable to diatomic molecules, undermining the belief in the absence of molecular reactivity in the ISM. It was only in the late sixties, after the birth of radioastronomy, that the first polyatomic molecules were identified. The first molecules discovered were: ammonia (NH_3) water (H_2O) and formaldehyde (H_2CO), the first organic molecule hydrocyanic acid (HCN) carbon monoxide (CO) and methanol (CH_3OH) formic acid (HCOOH and formamide (H_2NCHO). Since then, more than 200 molecules have been detected in the ISM and circumstellar shells and the rate of discovery continues at rapid pace. Interestingly, the molecules detected by radioastronomy, which range in size from diatomics up to 13 atoms, are overwhelmingly organic in nature. Particularly fascinating are the so-called "Complex Organic Molecules" (COMs) which are defined as molecules containing more than 5 atoms and including at least one carbon atom.

Shedding light on the chemistry occurring in space, i.e., understanding how molecules are formed and evolve, might help to set the stage for understanding the emergence of life on Earth and elsewhere (Christian, 2013). This aspect of Astrochemistry has attracted a lot of interest in all scientific community, but knowledge is still at a rather primitive stage. Two theories have been suggested so far on the emergence of life on our planet, exogenous delivery and endogenous synthesis, and we are far from stating with confidence if one or both of them are correct. Regardless of whether they were delivered to Earth from space or synthetized from simpler molecules, prebiotic species then evolved toward biological complexity, with astrochemistry then moving toward astrobiology. Then, it becomes impossible to place a dividing line between astrochemistry and astrobiology, with astrochemical and astrobiology challenges merging together (Alexander, 1992).

CONCLUSION

To summarize, the focus of astrochemistry is the investigation of chemical processes taking place in space, including molecular evolution and complexity. Molecules have been found everywhere in space: in the interstellar medium, in circumstellar shells, in pregalactic gas, in protostellar disks, and in the atmospheres of planets and stars. Molecules are thus ubiquitous and they can be considered unique probes of molecular excitation mechanisms, radiative transfer, and kinematics.

REFERENCE

Giovanni AC (2011). Shedding Light on the Fabric of Space-time. Astrophysics. 478(7370):466-467.

Rowe BR (1992). Chemical Reac tion in Astrochemistry. Chem Rev. 150(1):7-12.

Christian AG (2013). Solar Radiation Solar Radiation Spectrum Solar Radiation Spectrum. 608-633.

Alexander D (1992). Astrochemistry of Cosmic Phenomena: An Introduction.150:1-6.