Preface

Fullerenes show a remarkable stability both toward γ photons and cosmic rays suggesting that once formed they can survive in the harsh interstellar and circumstellar environment (Cataldo et al. 2009).

The main sources of carbon dust and molecules in the interstellar medium are the late-type carbon-rich stars, but there is a class of stars which lies in the transition between the asymptotic giant branch (AGB) to the planetary nebula stage which is very promising as sources of fullerenes. The stars in such class are rather rare, are helium rich and extremely depleted in hydrogen content in their gaseous shell so that the carbon vapour ejected from the star could be cooled in appropriate and ideal environment for the fullerene formation. The prototype of such stars where fullerene may be formed is the *R Coronae Borealis* class of stars (Kroto 2006). In the interstellar medium C_{60} fullerene should be present as neutral molecule or should undergo ionization to C_{60}^{+}. Such cation may be responsible for some spectral features in the diffuse interstellar bands (DIBs). Fullerene cations undergo multiple addition of atomic hydrogen forming hydrogenated derivatives (Petrie et al. 1995) but also neutral fullerenes add easily atomic hydrogen at very low temperatures (Howard 1993), it is reasonable to think that fulleranes, the hydrogenated fullerenes derivatives should be present in the interstellar medium (Petrie and Bohme 2000).

The first chapter from Iglesias-Groth and Cataldo reviews the potential contribution of single fullerenes and buckyonions to interstellar light extinction. Fulleranes prepared by atomic hydrogen treatment of fullerenes are the object of the study of Carraro, Maboudian and Stoldt. In particular laboratory spectra of fullerane show remarkable agreement with important features detected in the observational data, among others the so-called canonical interstellar spacing of infrared spectra and the single bump in the ultraviolet absorption spectra. The problem of molecular hydrogen formation in space starting from atomic hydrogen and interstellar carbon dust surfaces is addressed in Chapter 3. In particular the role played by fullerene-like structures and fullerenes present in the carbon dust in the molecular hydrogen formation is underlined. In Chapter 4, G. Kabo and colleagues present a detailed work on the thermodynamic properties of fullerene hydrides and their equilibria reaction. In particular, Kabo and colleague show that $C_{60}H_{36}$ can act as hydrogen accumulator. This point lead us from the astrophysical/astrochemical context through the physical chemistry into the potential practical applications of fullerene hydrides. The possibility to link chemically on a single C_{60} fullerene cage up to 30 hydrogen molecules and to reversibly get back such hydrogen is highly seductive and paves the way to use fullerenes or better fullerenic carbon as a substrate for the reversible accumulation and release of hydrogen used as energy vector in thermal engines. The advantage of such systems of hydrogen storage based on fullerenic carbon is the lightness and the high density of hydrogen molecules stored per unit volume in contrast to the classic metal hydrides systems which are extremely heavy. A. Talyzin in Chapter 5 presents a beautiful work dealing with the hydrogenation of fullerenes under high pressure and temperature. Indeed the systems analyzed by Talyzin show an exceptional tendency to accumulate hydrogen but the reverse reaction was not found fully reversible since the hydrogenated fullerene derivatives do not release back only hydrogen but also other decomposition products. In the following chapter, J.B. Briggs and G.P. Miller show a very surprising synthesis of fulleranes using polyamine. For example, the combination of microwave and polyamine leads to produce $C_{60}H_{18}$ in very high yields and in very short reaction times. Chapters 7 and 8 are dedicated respectively to the synthesis of perdeuterated derivatives of C_{60} and C_{70} fulleranes and to the study of their thermal and UV light stability. In the photolysis of fulleranes a remarkable isotope effect has been measured for the first time and these studies address again to the topic of the stability of the hydrogenated and deuterated fullerenes in space as well as the possible deuterium enrichment of the fulleranes in space (Cataldo and Iglesias-Groth 2009). Chapter 9 is a very detailed and interesting work on the NMR characterization of the chemical structures of fulleranes and their symmetries. Chapter 10 is dedicated to the low temperature infrared spectra of C_{60} and C_{70} fullerenes as well as $C_{60}H_{18}$ fullerane. The spectra were taken at temperature as low as 80 K and compared with high temperature spectra taken at 523 K and extrapolated to >1,000 K. The knowledge of the infrared spectra of fullerenes and fulleranes paves the way for their detection in the space. The chapter of Bazhenov, Bashkin and Meletov deals with the high temperature and high pressure hydrogenation of carbon nanostructures in a review that covers both potential materials science applications and the astrophysical implications. Finally, the last chapter, Chapter 12, discusses the application of topology in the calculation of the stability and symmetry of hydrogenated fullerenes. It is a purely theoretical chapter but whose conclusions are in agreement with the current knowledge about the symmetry and stability of certain fulleranes like $C_{60}H_{36}$. Thus, Chapter 12 shows how powerful is the modern topological approach in the calculation of the structures and stability of fulleranes and other fullerenes derivatives.

In conclusion, the book is a bridge among different disciplines ranging from chemistry to materials science to physics, astrophysics and topology with a unique final subject: showing the state of the art of the research on fulleranes, the hydrogenated derivatives of fullerenes.

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