

Separation of Fullerenes by
Liquid Chromatography

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Separation of Fullerenes by Liquid Chromatography

Edited by Kiyokatsu Jinno

Toyohashi University of Technology, Japan

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SEPARATION OF FULLERENES
BY LIQUID CHROMATOGRAPHY

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Preface

The history of fullerenes is highlighted by the following three important scientific findings: (1) in 1970 the presence of a round, hollow, geodesic sphere-shaped molecule consisting of 60 carbon atoms was predicted by Osawa (*Kagaku*, 1970, **25**, 854); (2) in 1985 this stable carbon molecule was actually observed in the mass spectrum of laser ablated graphite by Kroto *et al.* (*Nature*, 1985, **318**, 162); (3) Kratschmer *et al.* (*Chem. Phys. Lett.*, 1990, **170**, 167) finally found the method to prepare the microscopic quantities of this substance by resistive heating of graphite under an inert atmosphere, although before that time there was no evidence to prove the existence of this compound on the Earth. This compound, consisting of carbon atoms arranged to form 12 isolated pentagon and 20 hexagon rings, was named 'Buckminsterfullerene', 'Fullerene' or simply 'Bucky Ball', honouring Buckminster Fuller who was the artist in designing geodesic dome structures in Germany. Almost at the same time Kratschmer *et al.* (*Chem. Phys. Lett.*, 1990, **170**, 167) found the existence of C₇₀, consisting of 70 carbon atoms, as the second most abundant molecule formed by resistive heating of graphite. Since this discovery, fullerenes, because of their unique structures, have attracted the attention of many chemists, physicists and materials scientists in a wide variety of scientific fields. There have been many publications about their characteristics, which have been investigated using instrumental analytical techniques such as mass spectrometry (MS), nuclear magnetic resonance spectrometry (NMR), infrared spectrometry (IR), ultraviolet spectrometry (UV) and other spectrometric measurements. In order to obtain accurate spectrometric information, the isolation and purification of the compounds from the carbon soot mixtures is the key process in this scientific research field. Therefore various separation methods for the separation and purification of fullerenes and their derivatives have been proposed. It is clear that high-performance liquid chromatography (LC) is the most promising of these proposed methods but it requires good stationary phases for better separation performance.

Thus one can conclude that the construction of new separation systems which offer enhanced selectivity and performance for the separation of fullerenes is one of the most important tasks for separation scientists. There are huge demands for such systems to solve fullerene separation problems.

In this book, in order to emphasize the importance of LC techniques for the separation of fullerenes including C_{60} , C_{70} and higher than C_{70} , metallofullerenes and their derivatives, the recent approaches and efforts to fullerene separation by several research groups are described. As editor I would like to express my sincere thanks to those contributors who gave me their excellent chapters. I also appreciate very much the help of Dr. Hatsuichi Ohta in my research group who spent much time in reorganizing and retyping the chapters to ensure consistency. Finally I should thank the staff of the Royal Society of Chemistry who gave me this opportunity to make this kind of contribution to separation science and to fullerene-related science.

Kiyokatsu Jinno
Toyohashi, Japan

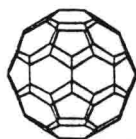
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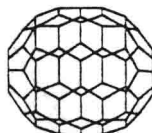
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Fullerene Gallery

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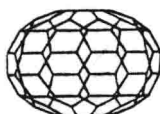


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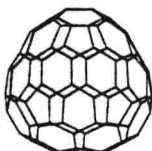
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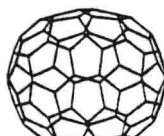
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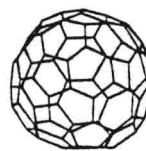


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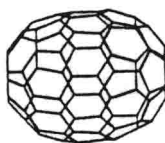


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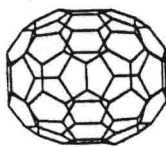


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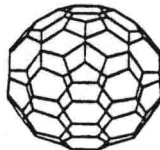
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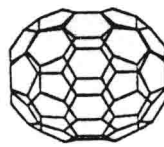
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C2v



C2v'

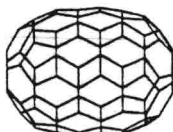


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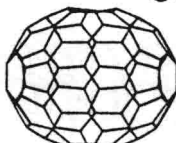


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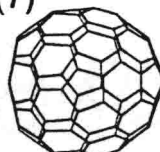
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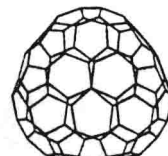
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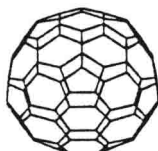
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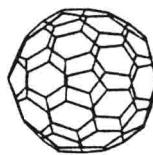
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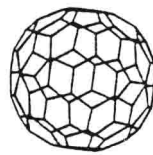
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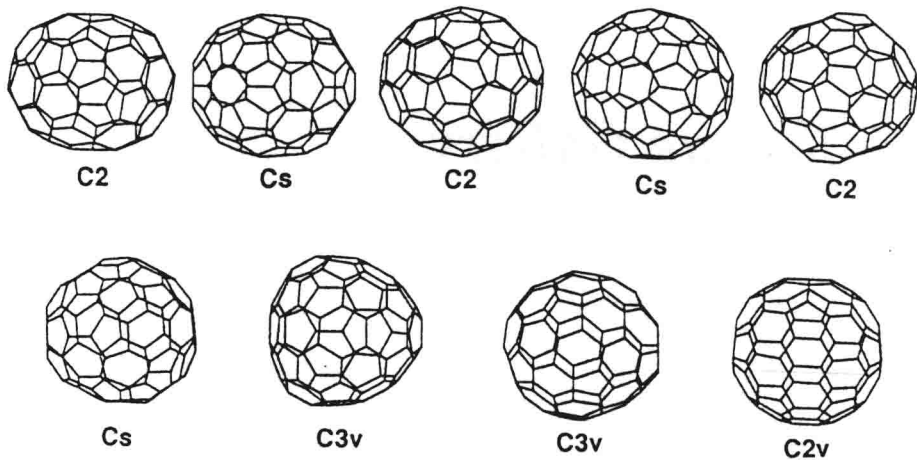
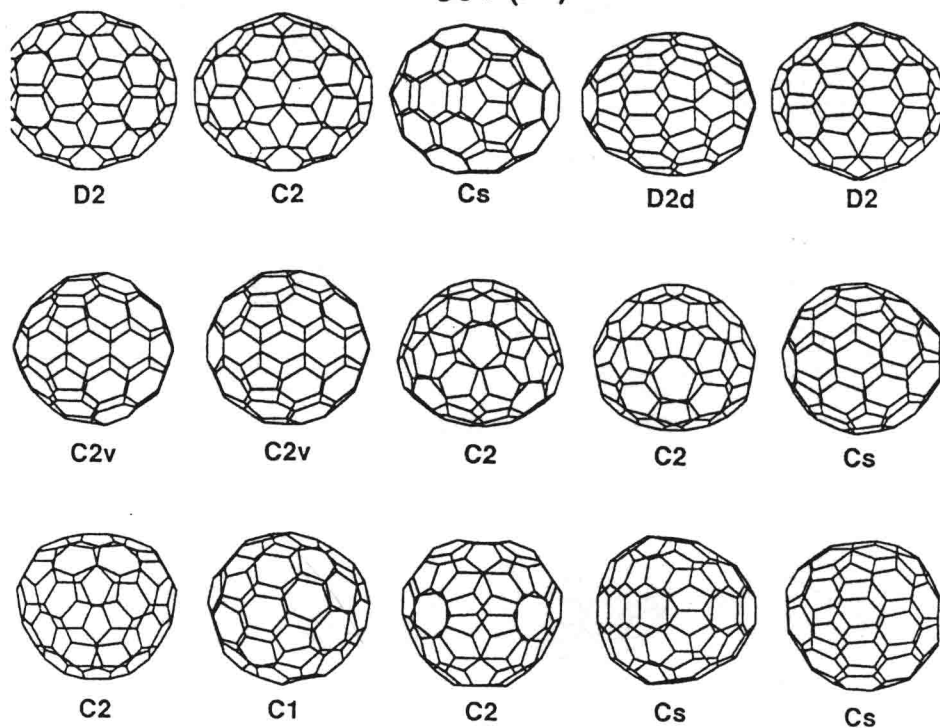
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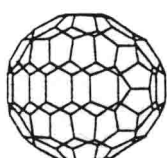
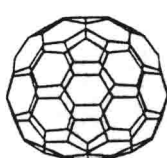
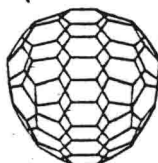
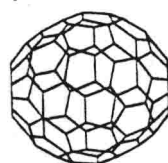
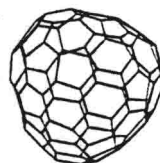
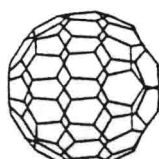
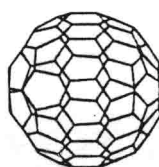
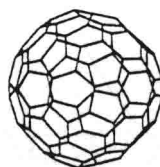
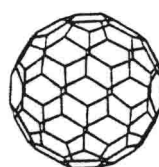
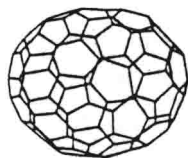
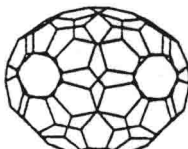
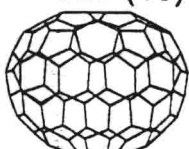
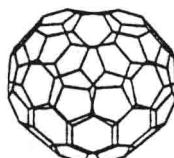
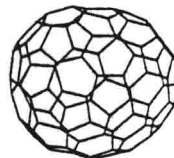
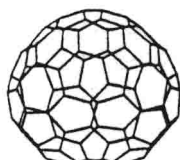
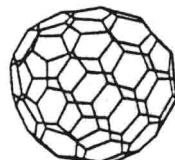
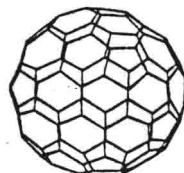
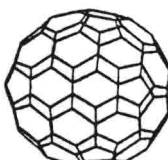
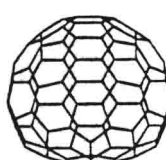
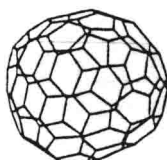
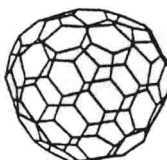
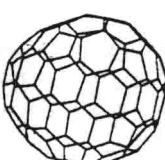
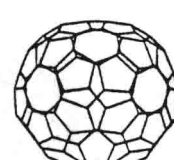
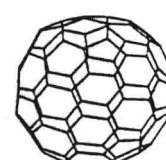


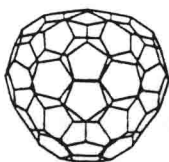
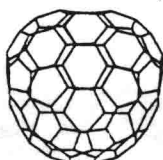
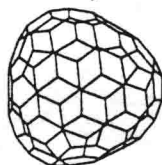
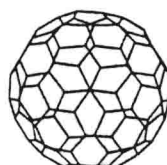
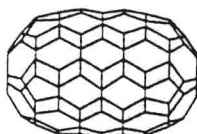
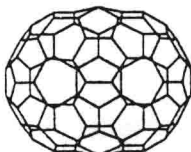
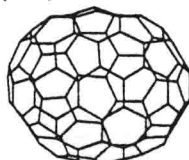
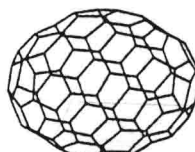
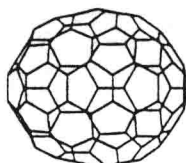
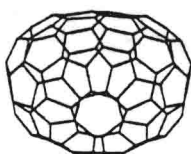
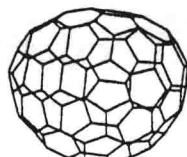
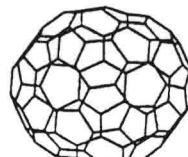
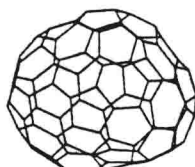
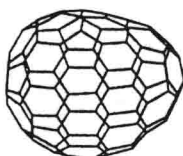
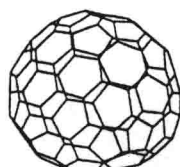
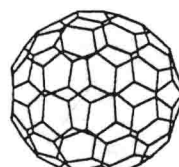
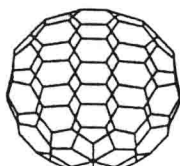
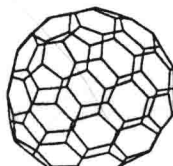
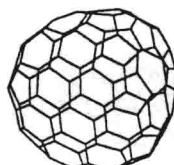
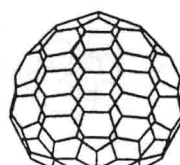
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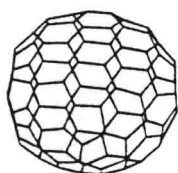
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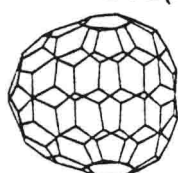
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C86(continued)**Cs****C2****C3****D3****C90 (46)****D5h****C2v****C1****C2****Cs****C2****C1****C2****C1****Cs****C1****C2****C2v****C1****C1****C2v**

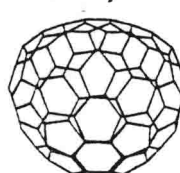
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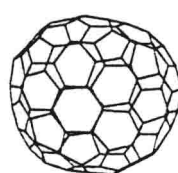
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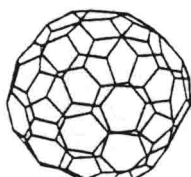
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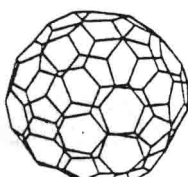
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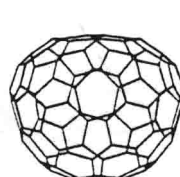
C1



C1



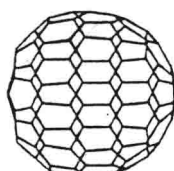
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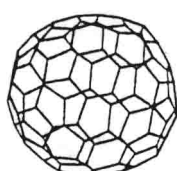
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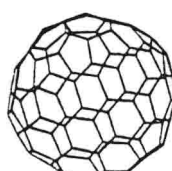
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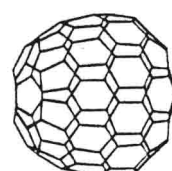
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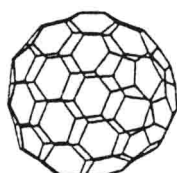
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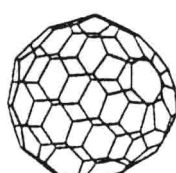
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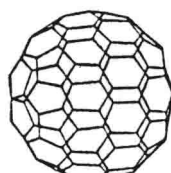
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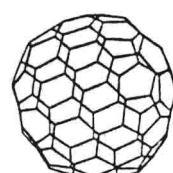
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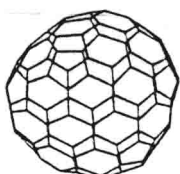
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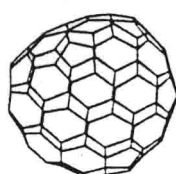
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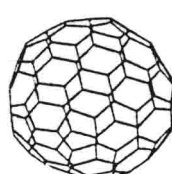
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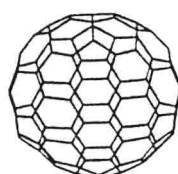
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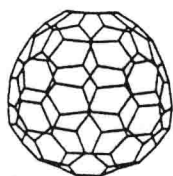
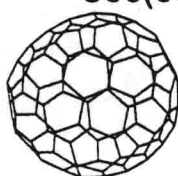
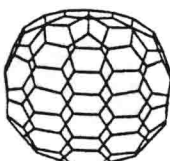
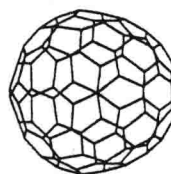
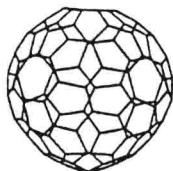
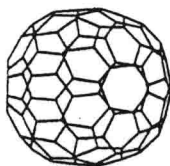
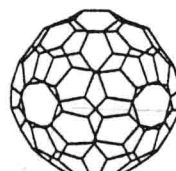
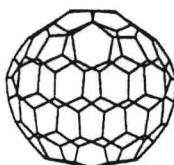
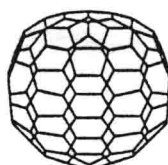
Cs



Cs



C2v

C90(continued)**C2****C1****C2v****C2****C2****C2****C2****C2****C2****C2v**

The fullerenes structures were obtained from the following URL:
<http://shachi.cochem2.tutkie.tut.ac.jp/Fuller/Fuller.html>

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