Preface

Organic solids are organic and polymeric materials with special functionalities that stem from our increasing ability to manipulate and tune the properties of organic and polymeric materials (e.g. optoelectronic properties). We achieve this through the systematic variation of their molecular components, to allow for molecular-level control of the solid-state structure via arrangement of the functional molecular components into a defined solid architecture.

The history of organic solids can be traced back to 1948 with the discovery of the semiconducting properties of organic dyes. However, organic solid became a mainstream research topic in the 1970s with the discovery of conducting polymers by Alan J. Heeger, Alan G. MacDiarmid and Hideki Shirakawa. They were awarded the Nobel Prize in Chemistry 2000 for “the discovery and development of conducting polymers”. Following this, the invention of high-efficiency organic light-emitting diodes by C. W. Tang (1987) and the discovery of polymer electroluminescence (1989) by Cambridge University (Richard Friend, Jeremy Burroughes, Donal Bradley) made the development of a superior flat-panel display technology possible. This display technology has been used in diverse applications ranging from cellular phones to large-area high-definition television screens. Simultaneously, the invention of organic heterojunction solar cells by C. W. Tang (1986) and the discovery of polymer bulk heterojunction solar cells (1994, 1995) by a University of California, Santa Barbara, group (Alan Heeger, Niyazi Serdar Sariciftci, Gang Yu) made a milestone contribution to the field of organic solar cells. Today, the quantum efficiency of organic solar cells is over 8%, which demonstrates their potential for practical applications in delivering cheap solar power. The invention of the organic field-effect transistor in 1986 (A. Tsumura, H. Koezuka, T. Ando) has resulted in a revolution in developing fast and inexpensive integrated circuits based on organic semiconductor elements. When combined with the advantage of solution processability, organic semiconductors allow for the use of a variety of printing techniques, such as inkjet printing and stamping, to fabricate large area devices at low cost. The mechanical properties of organic semiconductors

also allow for flexible electronics. However, the most distinguishing feature of organic semiconductors is their chemical versatility, which permits the incorporation of functionalities through molecular design. Organic integrated circuits have already been realized, which has accelerated the development of “plastic electronics” and “printed electronics”.

The research of organic solids in China was pioneered by Professor Qian Renyuan of the Institute of Chemistry, Chinese Academy of Sciences, in the mid-1970s. Since that time, research centers and institutions have been established with the support of the Ministry of Education of the People's Republic of China, the Chinese Academy of Sciences, the National Natural Science Foundation of China (NSFC), the Ministry of Science and Technology of the People's Republic of China (MOST) and local governments. The represented research covers most areas of the field of organic solids which include, but are not limited to, high-mobility organic semiconductors, high-efficiency light-emitting diodes and polymer and organic solar cells, high performance organic field-effect transistors and circuits, photodetectors, and molecular devices and circuits. The achievements in the above areas have had a global scientific impact. Moreover, they have resulted in commercially viable products such as organic photoconductors in copying machines and laser printers as well as full-color organic displays, shipping on industrial scales. For this special issue, leading Chinese researchers in organic solids have been invited to present recent work and progress in the field of organic solids. The present issue contains reviews and research papers, focusing on optoelectronic materials; self-assembled processes and products, and their corresponding devices; and new techniques in the study of organic solids.

Because it is a highly interdisciplinary science, the research and development of organic solids continually derives ideas, methods, and technologies from other research fields. Knowledge, results and techniques derived from chemistry, physics, materials science, semiconductors, electronics, nanotechnology and biology have been adopted in the design and development of organic solids. For example, the understanding of how the properties of materials relate

to their structure, and in turn how they affect device performance; modification and control of the interface between organic layers and organic/metal electrode; the understanding the processes that contribute to the operation of organic devices; and the integration of organic elements with existing silicon technology to realize high performance electronic devices and circuits, have all been crucial in the development of organic solids.

We would like to express our deep appreciation to Editorial Director, Dr. ZHU XiaoWen and Editor, Dr. TIAN Ying for their outstanding work in planning, organizing and editing, which has resulted in these papers being published in *Science China Chemistry* in a relatively short period of time. We would also like to thank all of the authors who contributed to this issue. Because of the limited volume of the issue, we sincerely regret that we were not able to include all of the excellent manuscripts submitted for this special issue. We hope that this compilation will be an

inspiration for other scientists in the field, and that it will motivate continuing efforts in each research area of the field of organic solids. We greatly appreciate any comments or suggestions from our readers.

Wenping Hu

Institute of Chemistry, Chinese Academy of Sciences

Yong Cao

Institute of Polymer optoelectronic materials and Devices,
South China University of Technology,

February 25, 2011

HU WenPing, received his Ph.D. from the Institute of Chemistry (1999), Chinese Academy of Sciences. As a research fellow of the Japan Society for the Promotion of Sciences and Alexander von Humboldt Foundation he worked at Osaka University and Stuttgart University for four years. Following this, he worked in Nippon Telephone and Telegraph (Japan) as a research associate. Then, he joined in Institute of Chemistry, as a permanent staff member. His research focus is on molecular electronics.

CAO Yong, was appointed Professor in the College of Materials Science and Institute of Polymer Optoelectronic Materials and Devices in the South China University of Technology, China in 1999. He received his B.A. in chemistry from Leningrad University (Russia) and his Ph.D. from Tokyo University (Japan). He has previously been: Professor, Institute of Chemistry, CAS, 1986–1988; Visiting Scientist, Institute of Polymer and Organic Solids, University of California, Santa Barbara, 1988–1990; and Senior Scientist, Uniax Corporation (Santa Barbara), 1990–1999. His current research interests include optoelectronic conjugated polymers, organic/inorganic nano-hybrids, and polymer-electroluminescent and photovoltaic devices.