



Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/gmcl20>

Foreword

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Version of record first published: 31 Jan 2007

To cite this article: Hiroo Inokuchi (2006): Foreword, *Molecular Crystals and Liquid Crystals*, 455:1, ix-xi

To link to this article: <http://dx.doi.org/10.1080/15421400600865431>

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Foreword

The 54th Fujihara Seminar “Organic Semiconductors and Conductors: Half Century and Future Prospects” was held on 31st August – 4th September, 2005 at Tomakomai, Hokkaido, Japan. The series of Fujihara Seminar is sponsored by Fuhihara Foundation of Science, which was established by Ginjiro Fujiwara. Tomakomai is the place where he made a center of paper industry in Japan, with the largest mill for newspapers in the world.

Half century ago, most people believed that organic materials are electrical insulators. A few groups in the world challenged this “common sense” at around 1950, and the modern studies of electrical properties of organic materials began. In 1950 Hideo Akamato and Hiroo Inokuchi experimentally found faint electrical conductivity of violanthrone, a condensed cyclic aromatic compound. Through various types of measurements such as photoconductivity for related compounds, they could confirm the electronic nature of conductivity, and named them *organic semiconductors*. The report was published in 1954 in *Bulletin of the Chemical Society of Japan*.

In the same year of 1954, remarkably high conductivity in perylene-halogen charge-transfer complexes was found by Hideo Akamatu, Hiroo Inokuchi, and Yoshio Matsunaga. This study of halogen-doped organic complexes opened the gate to organic conductors.

After half century from these, the concepts of “organic semiconductors” and “organic conductors” have been well established. The field grew up rapidly, with landmarks such as the application to xerography and the discoveries of conducting polymers and organic superconductors. Various new materials, such as tetracyanoquinodimethane (TCNQ), tetrathiafulvalene (TTF), sulfur nitride (SN)_x, polyacetylene, tetramethyltetraselenafulvalene (TMTSF), bis(ethylenedithiolo)-TTF (BEDT-TTF), and C₆₀ were found on this way. The basic studies of various properties (carrier mobility, ionization energy, electron affinity, band structure, pressure effect, photoconductivity, etc.) were also carried out, making our understanding wider and deeper.

About 15 years ago (1988), the honorary chairperson of the present meeting (H.I.) organized an Oji Seminar (former name of Fujihara Seminar) with the title of “Organic Semiconductors – 40 Years,” and summarized the development of the field in 40 years. With the

cooperation of the participants, a good record of the early days of this field in various countries and discussion on selected key concepts were compiled as the Proceeding in *Molecular Crystals and Liquid Crystals* (Volume 171 (1989)).

Just at around this time, new breakthroughs were brought about in practical applications, *i.e.* organic light emitting devices and organic photovoltaic cells. This soon led to the very active research and development both at academia and industries. Now OLEDs are commercialized, and the studies of photovoltaic cells and organic thin film transistors are following. Also we note the rise of research on nanocarbon systems such as fullerenes, nanotubes, and nanohorns, in parallel with the studies of molecular-scale devices and the studies of bio-related materials.

Thus it looked a good time to have another meeting summarizing the recent developments, with a wide scope spanning the half century of developments and some focus on the development of molecular electronics after this Oji Seminar.

The scope and aim of the present Seminar was stated as follows:

This meeting is commemorating the start of modern studies of organic semiconductors and conductors, which took place about 50 years ago in a few places in the world. Also we will examine the present status of the extended fields related to organic semiconductors and conductors, and discuss the opportunities in future, with some flavor of history. The subjects will include the basics and applications of organic molecular semiconductors and polymers, materials, molecular conductors, molecular scale electronics, fullerenes and nanotubes, and bio-related materials. We suppose that this meeting will offer a chance of tracing the remarkable expansion of the field, and also looking at the now diverse field from a unified viewpoint.

There were 102 participants from 5 countries, including 89 from Japan. The Seminar consisted of oral sessions with 24 invited speakers, a rump session on organic field-effect transistors, and a poster session. The meeting started with the talk on the early days of research in this field by Inokuchi. Many of the speakers included some historical aspects in their talks, which made the meeting a good occasion for looking back the half century of the now widely extended field, learning from still stimulating ideas of pioneers. There were much scientific stimulation and discussion, with the kind participation of eminent researchers. The meeting also offered a chance of communication among the now somewhat split fields of organic semiconductors, conductors, superconductors, carbon nanomaterials, molecular scale electronics, and bio-related materials. As the historical record, the above

mentioned Proceeding volume of *MCLC* in 1989 was reprinted and distributed to the participants, with the kind cooperation of the Taylor and Francis.

We thank all the participants for the excellent presentations and vigorous discussion. Also we express our sincere thanks to Fujihara Foundation of Science for enabling this meeting as one of the Fujihara Seminar with long and proud tradition.

On behalf of the Organizing Committee

Hiroo Inokuchi
Honorary Chairperson,
Kazuhiko Seki
Chairperson