

# Science and Technology of Polymers and Advanced Materials



Edited by  
Paras N. Prasad, James E. Mark,  
Sherif H. Kandil, and Zakya H. Kafafi

# Science and Technology of Polymers and Advanced Materials

## Emerging Technologies and Business Opportunities

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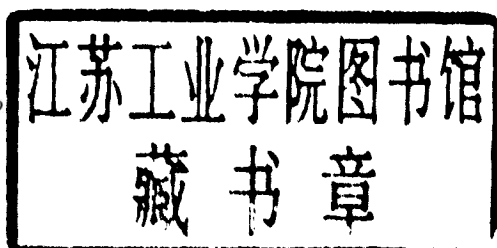
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## PREFACE

This book summarizes the state of the art research presented at the ***Fourth International Conference on Frontiers of Polymers and Advanced Materials*** held in ***Cairo, Egypt*** in January 4-9, 1997. This conference follows the successful conferences held in Kuala Lumpur, Malaysia in 1995, in Jakarta, Indonesia in 1993 and in New Delhi, India in 1991. These conferences focussed on the most recent and important advances in a wide range of carefully chosen subject areas dealing with advanced materials, their science and technology and new business opportunities resulting from recent technological advances. As its predecessors, the conference held in Cairo was truly international with strong participation of ***488 delegates representing 37 countries*** from the USA and Egypt, as well as Europe, South East Asia, Japan, South Africa and the Middle East.

The conference was organized by the Egyptian Academy of Scientific Research and Technology, The Arab Society of Materials Science and the State University of New York at Buffalo. The stated goals of the conference were:

- To highlight *advances and new findings* in the general area of polymers and advanced materials.
- To foster *global collaboration* between the USA, Egypt and other nations in the general field of polymers and advanced materials.
- To promote the *development of scientific infrastructure* in this field among the different participating countries, especially in the *Middle East*.
- To create a *basis for future long-term scientific exchanges* between the USA and Egypt, and/or other countries.
- To induce Egypt and other countries in the Middle East to move to advanced polymer/ceramic production via international cooperation.
- To prevent environmental contamination in the region through *enhancing production of environmentally compatible polymers* in existing polymer production.

At the inaugural session, distinguished guests were present and gave short speeches on the importance of such conferences for the promotion of collaboration between scientists, industrialists and business people worldwide. The ***Head of the Egyptian Academy of Scientific Research and Technology*** who was also the ***National Chairperson*** of the conference, ***Dr. Hamdy Abdel Aziz Moursy***, opened the conference and introduced the keynote speaker ***The Minister of State for Scientific Research, Dr. Venice Gouda***. Dr. Gouda congratulated ***Professor Paras Prasad, The International Chairperson***, for bringing this conference to Egypt. She commented that this conference was timely due to the recent science and technology agreement signed between the U.S.A. and Egypt as part of the Gore-Mubarak initiative. ***Dr. Nawal El-Tatawy, Minister of Economy and International Cooperation***, gave a speech pointing to the importance of science and technology in the development of the Egyptian economy through small businesses and entrepreneurial effort. ***Dr.***



**Mohamed El-Ghamaraawy, Minister of State of Military Production** welcomed the business forum of the conference. This was followed by a speech from **Mr. John Wisley, the Head of USAID Mission to Egypt** who represented the American Ambassador,. **The Japanese ambassador, Kunio Katakura** made the final concluding remarks at the Inaugural session.

The proceedings reflect the subjects of the **288 oral and poster presentations** discussed in **60 technical sessions** which were held in **eight parallel symposia** on **1. Composites and Blends, 2. High Performance Materials, 3. Materials for Electronics and Photonics, 4. Biomaterials and Biotechnology, 5. Degradation, Stabilization and Recycling of Materials, and Environmentally Friendly Processing, 6. Sol-Gel Processed Materials, 7. Advanced Materials from Natural and Petroleum Products, and 8. Materials for Separation Technology.** There was also a **Business Symposium** focussing on new business opportunities and finances, technology transfer and investment, international licensing and patents as well as another session for **Educational Needs and Trends.**

The Editors gratefully acknowledge the help and cooperation of the members of the International and National Advisory Committees, and the International and National, Program Committees. Special thanks go to the Honorary Chairperson, Dr. Venice Kamel Gouda, Minister of Scientific Research, Arab Republic of Egypt, and the members of the Honorary Council. The conference sponsorships were provided by Ministry of Economics and International Cooperation, Egypt; Cabinet's Information and Decision Support Center (IDSC) Cairo, Egypt; Dow Corning, USA; European Office of Aerospace Research and Development, U. S. Air Force; European Research Office, United States Army; Hoechst - Celanese, USA; International Development Research Centre, IDRC. Canada; International Institute of Theoretical Physics Trieste, Italy; Office of Naval Research, Europe; Office of Naval Research, USA; Saudi Basic Industries Corporation (SABIC); Social Fund for Development, Egypt and TORAY Industries, Japan.

It is our hope that this book will serve as a useful reference for researchers in academic, industrial and research institutes as well as for those interested in new business opportunities in the field of Polymers and Advanced Materials.

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# LIGHT AND THE NEW CHEMISTRY

## - EXPECTATION FOR PHOTO TECHNOLOGIES





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### THE DAWN OF PHOTOCHEMISTRY

Sun light has been providing clean energy on the Earth since the mythical age. Almost all livings on the Earth have been benefiting from the solar energy through photochemical and biochemical processes in nature. So, photochemistry is fundamentally an eco- and human-friendly technology. However, it took us a long time to utilize the photochemical reaction practically. Table 1 shows the epoch-making discoveries at the dawn of photochemistry.

Table 1. The Dawn of Photochemistry

<b>Schultz (1727)</b>	$\text{Ag}_2\text{CO}_3$	$\xrightarrow{h\nu}$	Decomposition Residue
<b>Daguerre (1840)</b>	$\text{AgI}$	$\xrightarrow{h\nu}$	$\text{Ag} + 1/2 \text{I}_2$
<b>Draper (1850)</b>	$\text{H}_2 + \text{Cl}_2$	$\xrightarrow{h\nu}$	$2\text{HCl}$
<b>Einstein (1910)</b>	Law of Photochemical Equivalency (Einstein-Stark's Law)		
<b>Lynn (1919)</b>	$\text{C}_7\text{H}_{16} + \text{NOCl}$	$\xrightarrow{h\nu}$	$\text{C}_7\text{H}_{14} = \text{NOH} \cdot \text{HCl}$
<b>Linden Taylor (1921) (1945)</b>	 + $3\text{Cl}_2$	$\xrightarrow{h\nu}$	
<b>Ito (1951)</b>	 + $\text{NOCl}$	$\xrightarrow{h\nu}$	 = $\text{NOH} \cdot 2\text{HCl}$

In 1727, about 300 years ago, a German medical doctor Schulz found that silver carbonate decomposes under sun light. Then, 100 years later from his discovery, Dr. Daguerre in France invented the basic technology of photography based on silver salt reaction. This was