CHEMISTRY of MATERIALS

VOLUME 1, NUMBER 1 JANUARY/FEBRUARY 1989

Editorial

Chemistry of Materials—The Newest ACS Journal

It is with great pleasure that we present to you the premier issue of *Chemistry of Materials*. As a periodical of the American Chemical Society, this journal joins a prestigious group of publications that has as its purpose "the advancement of chemistry in all its branches", "the promotion of research in chemical science and industry", and "the increase and diffusion of chemical knowledge".[1] The publication of *Chemistry of Materials* extends the coverage of ACS journals to include the broad interface area between chemistry and materials science.

The impetus for this new journal arose from a growing recognition of the importance of chemistry to materials science and the increasing involvement of chemists and chemical engineers in materials preparation and processing. This current worldwide focus on materials chemistry is apparent from the programs and publications of both chemical and materials research societies. However, the assocation of chemistry with materials science is by no means a new phenomenon. Rather, the relationship of chemistry with the preparation and processing of materials is at least as old as chemistry itself, and much of modern materials science and technology owes its existence and continued development to chemistry.

The current focus on chemistry as a solution to materials-related problems encompasses all of the major chemical and chemical engineering disciplines and involves everything from the development of new materials to the processing and preservation of existing materials. In the context of materials processing, there is an increasing demand for better methods of obtaining known materials in unusual forms such as epitaxial thin films, stable colloidal suspensions, and microporous membranes.

Another important theme in materials research is the interaction between materials and their environment, for example, in connection with heterogeneous catalysis, corrosion, adhesion, abrasion resistance, the design of biomaterials, chemical sensors, and thin-film deposition. The full understanding and control of these processes depend to a large extent on the skills of both chemists and chemical engineers who are trained in areas such as surface science, analytical chemistry, chemical kinetics, and thermodynamics, as well as in the theory and modeling of chemical processes.

A common focus for these and many other areas of activity in materials science is the application of chemical methodology and a molecular-level viewpoint to the understanding and control of the properties and behavior of materials. This basic commonality has become clouded by efforts to categorize such activities in terms of the type of material or discipline involved. As a result, research papers in this interface area have been widely scattered throughout the literature, and the basic focus on chemistry has become obscured.

A major objective of *Chemistry of Materials* is to provide a forum for work in materials-related chemistry and to highlight the pivotal role of chemistry as a source of new materials and approaches to materials processing. This journal is intended to serve as a bridge between the disciplines of chemistry and materials science and to make the area of materials chemistry more visible to the chemical and materials communities. In so doing, it should stimulate further efforts by chemists and chemical engineers to develop improved materials and to provide a better understanding of chemical processes in materials science.

Chemistry of Materials is envisioned as a primary research journal that emphasizes the chemical and fundamental aspects of materials science that underlie current and future materials technology. Therefore, papers that reflect a strong commitment to basic research in materials chemistry and report significant new findings that may help to advance the level of fundamental understanding in this area are especially sought. These papers may take the form of preliminary communications or full papers, as well as selected short reviews.

(1) Bylaws of the American Chemical Society, Article II, Section 1.

0897-4756/89/2801-0001$01.50/0

Relevant topics for *Chemistry of Materials* include both theoretical and experimental studies that focus on the preparation, characterization, processing, or understanding of materials with unusual or useful properties. Of particular importance are the originality, significance, overall quality, and completeness of the work as well as its relevance to both chemistry and materials science. The last of these considerations, in particular, serves to define the particular focus of this journal and the special niche that it seeks to fill among periodicals in materials science.

Recognizing the international scope and the breadth of the subject, the Editorial Advisory Board of *Chemistry of Materials* has been selected to ensure a strong international representation as well as a broad perspective on the wide range of subjects in materials chemistry. Included on the Advisory Board are over sixty scientists and engineers from academic, industrial, and governmental laboratories in ten different countries. The articles scheduled for publication in the first few issues are illustrative of this broad, international perspective on materials chemistry. Among the topics covered are molecular and polymeric conductors, nonlinear optical materials, thin-film resists, various aspects of solid-state inorganic chemistry including high-T_c superconductors, sol–gel processing, chemical vapor deposition, ceramic precursors, biosensors, colloid chemistry, electronic materials processing, heterogeneous catalysis, and many other subjects at the forefront of current research in materials chemistry. This broad perspective on fundamental research in materials chemistry will continue in the future issues of this journal.

Last but by no means least, I would like to thank those whose efforts have led to the realization of this journal. These efforts began over four years ago with the establishment of a task force to investigate the need for such a journal. The report of this task force and that of the subsequent selection committee for the journal editor have played an important role in the definition of the scope and purpose of *Chemistry of Materials*. During the past year, the dedicated efforts of the Washington, D.C., and Columbus, Ohio, staff of the ACS Publications Division have resulted in the transformation of these ideas into a functioning journal. Special thanks also go to the two Associate Editors, Dennis Hess and Gary Wnek, and the members of the Editorial Advisory Board, who have been called upon frequently in this last year for advice, reviews of manuscripts, and their own papers. Finally, all of the authors who have responded so enthusiastically to our call for papers and the reviewers who have given their time to provide the critical evaluation of the submitted papers deserve the major credit for getting this journal off to such a flying start.

Leonard V. Interrante

Communications

Potential Dependence of the Relative Conductivity of Poly(3-methylthiophene): Electrochemical Reduction in Acetonitrile and Liquid Ammonia

Richard M. Crooks, Oliver M. R. Chyan, and Mark S. Wrighton*

Department of Chemistry
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Received August 23, 1988

We report chemically reversible electrochemical reduction of poly(3-methylthiophene) and electrical and optical properties for the reduced material. It is well-known that large increases in conductivity occur upon oxidation of a number of thiophene-based polymers.[1,2] Recently, conducting polymers have been shown to have a finite potential window of high conductivity upon oxidation.[3-5] In the case of poly(3-methylthiophene)[3] oxidation to yield the nonconducting oxidized state requires the use of unusual media to minimize degradation. This result has prompted us to examine poly(3-methylthiophene) at the opposite extreme, reduction, to completely define the potential dependence of conductivity. There are reports of the electrochemical reduction of polythiophene,[6] poly(isothianaphthene),[7] and poly(3-phenylthiophene),[8] but characterization of the reduced polymers has been elusive owing to their rapid degradation.

We present here conditions (low temperature and H_2O-free, CH_3CN/- or NH_3/electrolyte media) for chemically reversible reduction of polythiophenes. It has been shown that NH_3 is an excellent solvent for stabilizing radical anions and dianions,[9-11] and we thought it would be an appropriate solvent for studying the reduced forms of conducting polymers. Our studies have involved use of a vacuum-tight, two-compartment cell.[12,13] The cell was first oven dried and transferred to an inert-atmosphere box for assembly and addition of electrolytes, then removed, and attached to a vacuum line. The electrolytes were dried in situ at elevated temperature until an ultimate vacuum of 10^{-6} Torr was obtained. NH_3 was distilled from Na into the electrochemical cell, or CH_3CN was triply distilled from P_2O_5 into the cell. All potentials are reported versus a Ag wire quasi-reference electrode. We have used the poten-

* Author to whom correspondence should be addressed.

(1) Tourillon, G. *Handbook of Conducting Polymers*; Skotheim, T. A., Ed.; Marcel Dekker: New York, 1986; Vol. 1, Chapter 9.
(2) Chandler, G. K.; Pletcher, D. *Electrochemistry*; Pletcher, D., Ed.; Royal Society of Chemistry: London, 1985; Vol. 10, Chapter 3.
(3) Ofer, D.; Wrighton, M. S. *J. Am. Chem. Soc.* **1988**, *110*, 4467–4468.
(4) Paul, E. W.; Ricco, A. J.; Wrighton, M. S. *J. Phys. Chem.* **1985**, *89*, 1441–1447.
(5) Chao, S.; Wrighton, M. S. *J. Am. Chem. Soc.* **1987**, *109*, 6627–6631.
(6) Kaneto, K.; Ura, S.; Yoshino, K.; Inuishi, Y. *Jpn. J. Appl. Phys., Part 2* **1984**, *23*, 189–191.
(7) Kobayashi, M.; Colaneri, N.; Boysel, M.; Wudl, F.; Heeger, A. J. *J. Chem. Phys.* **1985**, *82*, 5717–5723.
(8) Sato, M.; Tanaka, S.; Kaeriyama, K. *J. Chem. Soc., Chem. Commun.* **1987**, 1725–1726.
(9) Demortier, A.; Bard, A. J. *J. Am. Chem. Soc.* **1973**, *95*, 3495–3500.
(10) Smith, W. H.; Bard, A. J. *J. Am. Chem. Soc.* **1975**, *97*, 5203–5209.
(11) Crooks, R. M.; Bard, A. J. *J. Phys. Chem.* **1987**, *91*, 1274–1284.
(12) Bard, A. J.; Faulkner, L. R. *Electrochemical Methods*; Marcel Dekker: New York, 1980; p 25.
(13) Gaudiello, J. G.; Bradley, P. G.; Norton, K. A.; Woodruff, W. H.; Bard, A. J. *Inorg. Chem.* **1984**, *23*, 3–10.

0897-4756/89/2801-0002$01.50/0