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Introduction

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Introduction

There has been increasing recognition during the past 2 decades of the importance of the plasma chemistry of polymers. However, literature in this field tends to be scattered in journals of a variety of disciplines. In an effort to bring this subject to the attention of the community of polymer scientists, the Symposium on Plasma Chemistry of Polymers was organized under the sponsorship of the Division of Polymer Chemistry of the American Chemical Society, and was held in Philadelphia on April 7 and 8, 1975 during the 169th National ACS Meeting. The proceedings of this symposium are recorded in this volume.

Although the first reported experiment on plasma polymerization was published in 1796 in Annals de Chimie by four Dutch investigators, it has received relatively little attention by polymer chemists in the ensuing centuries. Broadly defined, plasma polymerization can take place in the gaseous plasma created by a glow discharge, a corona discharge, an electron beam, or a laser. Organic or organometallic vapors introduced into the plasma are converted into ions, free radicals, or excited molecules. The reaction of these species with the monomer and with themselves leads to the formation of highly cross-linked and branched polymers. Because of the very high energy available in the plasma, practically any organic or organometallic compound can be polymerized, including those which are devoid of the functional groups normally required in conventional polymerizations.

In addition to the actual production of polymers, inert gas plasma can also be used to modify the surface characteristics of conventional polymers. For instance, CASING (Cross-linking by Active Species of INert Gases) is a well-known technique to improve the properties of conventional polyethylene. The current state-of-the-art knowledge of both plasma polymerization and plasma surface treatment of polymers is reviewed in the two invited papers by Bell and by Yasuda. A quantitative model for plasma polymerization is proposed by Lam, Baddour, and Stancell,

which is based on a free-radical mechanism. The importance of free radicals in plasma polymerization and in plasma surface treatment is demonstrated by Morosoff and co-workers. However, Smolinsky and Vasile show by mass spectrometry that ionic species were predominant in their plasma. Perhaps one potentially useful technique to resolve this apparent paradox will be the plasma diagnostic method proposed by Coburn and Kay.

Kobayashi, Bell, and Shen studied the effect of reactor variables on the plasma polymerization of hydrocarbons. Both the works of Morita, Sawa, and Ieda and of Tibbitt, Bell, and Shen report on the relation of plasma-polymerized hydrocarbons to their electrical properties. On the other hand, the papers by Dynes and Kaelble, by Washo, and by O'Kane and Rice investigate the structure-property relations for plasma-polymerized fluorocarbons, with an emphasis on surface properties. The utility of x-ray photoelectron spectroscopy in the surface characterization of plasma-polymerized fluorocarbons is studied in detail by Millard and Pavlath.

A number of potential uses for plasma-polymerized films have been investigated in the past. These included the production of thin-film capacitors, protective coatings for semiconductor devices, and anticorrosive coatings for containers. More recent investigations have focused on the use of such films for laser light guides, optical coatings, and reverse osmosis membranes. At this symposium a novel application of plasma surface treatment is suggested by Reneker and Bolz as a method of thinning crystalline polyethylene to render it possible to study its morphology below the surface. Finally, two important practical uses of plasma treatment are demonstrated by Schreiber and co-workers for improving the properties of composite materials, and by Pavlath and Lee for the shrinkproofing of wool.

Interest in the plasma chemistry of polymers is not only demonstrated by both the quality and quantity of the contributions, but also by the persistent high attendance at all sessions of the symposium. I attribute the success of this symposium to the cooperation and enthusiasm of all the participants. In addition, I am especially indebted to Drs. A. T. Bell and J. R. Hollahan for their counsel and assistance in the planning stage as members of the Program Committee, and during the symposium as session chairmen. Finally, I thank the ACS Division of Polymer Chemistry for having bestowed upon me the pleasure of organizing this symposium.

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