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New methods have been developed for the synthesis of polyphosphazenes, including
those with transition metals and pseudo-halogen units in the side chains. Studies have
been carried out to generate structure-property correlations in phosphazene high polymers.DTIC
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THE SYNTHESIS AND STRUCTURE OF POLYPHOSPHAZENES

Final Report

Harry R. Allcock

June 13, 1988

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Department of Chemistry
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The objective of this work was the synthesis and evaluation of new polymers derived from the inorganic elements. Specifically, the goal was to develop new methods of synthesis for polyphosphazenes and to develop an understanding of the ways in which changes in molecular structure alter the properties of the polymers and allow improved polymers to be designed.

First, a method has been developed for the synthesis of new polyphosphazenes with cyano side groups, and these have been used as precursors for the construction of organic side groups derived from the phosphazene-nitrile structure. The new polymers are expected to be useful as new films and elastomers.

Second, a number of new classes of cyclo- and polyphosphazenes have been prepared that incorporate transition metals, such as iron, ruthenium, chromium, or cobalt into the organometallic side group structure. These macromolecules are hybrid polymer-metal materials, some of which combine the properties of organic polymers with those of metals. Typical of these materials are polyphosphazenes with ferrocene units as side groups. These show semiconductor properties and unusual oxidation-reduction behavior.

Third, a series of small molecule linear phosphazenes have been prepared that serve as synthetic and structural models for the high polymers. X-Ray diffraction structure studies and theoretical analysis of the results have helped to predict ways in which the properties of the analogous polymers can be changed in order to optimize properties that are needed for advanced engineering uses.

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