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Structural Design of Conjugated Polymers Showing Excellent Charge Transport Toward Thermoelectric

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BRIEF REPORT

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Polymers in which phosphorus is an integral part of the main chain, including polyphosphazenes and polyphosphoesters, have been widely investigated in recent years for their potential in a number of therapeutic applications. Phosphorus, as the central feature of these polymers, endears the chemical functionalization, and in some cases (bio) degradability, to facilitate their use in such therapeutic formulations. Recent advances in the synthetic polymer chemistry have allowed for controlled synthesis methods in order to prepare the complex macromolecular structures required, alongside the control and reproducibility desired for such medical applications.

While the main polymer families described herein, polyphosphazenes and polyphosphoesters and their analogues, as well as phosphorus-based dendrites, have hitherto predominantly been investigated in isolation from one another, this review aims to highlight and bring together some of this research. In doing so, the focus is placed on the essential, and often mutual, design features and structure-property relationships that allow the preparation of such functional materials. The first part of the review details the relevant features of phosphorus-containing polymers in respect to their use in therapeutic applications, while the second part highlights some recent and innovative applications, offering insights into the most state-of-the-art research on phosphorus-based polymers in a therapeutic context. Controlled polymerization through living radical polymerization is widely studied. Controlled polymerization enables synthetic polymers with precise structures, which have the potential for excellent bio-functional materials.

This review summarizes the applications of controlled polymers, especially those via living radical polymerization, to bio functional materials and conjugation with biomolecules. In the case of polymer ligands like glycopolymers, the polymers control the interactions with proteins and cells based on the precise polymer structures. Living radical polymerization enables the conjugation of polymers to proteins, antibodies, nucleic acids and cells. Those polymer conjugations are a sophisticated method to modify bio-organisms. The polymer conjugations expand the potential of bio functional materials and are useful for understanding biology. This feature article provides both a critical perspective as to where synthetic 2D polymers currently stand and a rather substantial view into how the future of this exciting field of polymer chemistry might look. It starts out by addressing strategic considerations meant to familiarize the reader with what to expect when entering the field. To better understand these considerations, the very nature of a 2D polymer is addressed in comparison to other organic 2D materials. Thereafter, the article moves quite intensely and critically into synthetic and mechanistic issues of 2D polymers before concentrating on the important structural analytics that one has to go through when unequivocally establishing these novel sheet-like polymeric objects. After a short excursion into the matter of exfoliation, the feature article then culminates in a section attempting to forecast the future. Key differences between 1D and 2D polymers are highlighted, and those considered by the authors to be the most attractive and burning research goals are further discussed. It is hoped that the reader will find this speculative section inspiring enough such that ideas that will help in advancing 2D polymers even faster are generated.

Electro-responsive smart electro rheological (ER) fluids consist of electrically polarizing organic or inorganic particles and insulating oils in general. In this study, we focus on various conducting polymers of polyaniline and its derivatives and

copolymers, along with polypyrrole and poly(ionic liquid), which are adopted as smart and functional materials in ER fluids. Their ER characteristics, including viscoelastic behaviours of shear stress, yield stress, and dynamic moduli, and dielectric properties are expounded and appraised using polarizability measurement, flow curve testing, inductance-capacitance-resistance meter testing, and several rheological equations of state. Furthermore, their potential industrial applications are also covered.

Conjugated polymers, especially their second generation with a donor-acceptor alternating structure, have promising properties. These are suitable for two emerging fields, thermoelectric and bioelectronics if appropriate structural designs are implemented. This review aims to give a perspective for the potential and challenges of novel conjugated polymers in such applications. In particular, the aspects of synthetic design and the consequences of modifications of the chemical structure on the charge transport in selected second-generation conjugated polymers are reviewed. By understanding the effects of structural motifs on the overall material properties, polymers can be specifically tailored for the respective application. The basics of charge transport measurements are briefly summarized, as the charge transport plays an important role for thermoelectric as well as for bioelectronics. In particular, the correlation between the reported charge carrier mobility values and the structural design of the polymers is reviewed. Examples of the application of second-generation conducting polymers in thermoelectric and bioelectronics are shown to demonstrate the current state of research. Finally, the prospect of a purposeful design of new materials for these two emerging fields is discussed.