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Principles and Functional Approaches of Polymers

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DESCRIPTION

The study of polymers has seen significant diversification in recent years. Sequence-controlled polymers for use in information storage, smart and responsive, potentially self-healing polymers, and the expanding cut-set with the biological sciences, such as peptide/protein mimetics, are the "hot issues" of the last 10 years in polymer chemistry fundamental research. The characteristics of self-organized nanostructured polymers and nanocomposites, semiconducting polymers, polymers at interfaces, and a better comprehension of branching or cross-linked topologies may be mentioned in the context of physics.

The demand for advances in the domains of thermosets, rubbers, engineering plastics, and commodity plastics, which are created naturally in the more applied disciplines and of course in industry research, has only been partially answered by all these exciting advancements. For foundational technologies like electric mobility or additive manufacturing, where low-cost high-performance building materials, maybe as lightweight composites, have never been more in demand, improved polymeric materials are crucial. This viewpoint goes into great detail on a couple of the aforementioned subjects from a very personal perspective, revolving around the latter problem, which gets us to the maybe most important issue in modern polymer science: How can scientists help shift society away from often disposable single-use items and toward a completely sustainable, circular plastics economy? At the conclusion, I'll discuss some significant contributions polymer theory and physics may be able to provide, particularly for the life sciences' theoretical underpinnings. In actuality, high polymers have never been subject to any kind of regulation since they are considered to be fundamentally non-toxic. As a result, plastic garbage is increasingly pervasive in our environment, ranging in size from microscopic particles (such as fishing nets in the oceans, which are the main offender) to micro-and nano-sized fragments. Global agreement appears to have been achieved that this development must be stopped, despite the fact that we still have a long way to go in comprehending the effects and potential courses of action. Another related and equally significant reason to re-evaluate the plastics business and, by extension, polymer research, is climate change and the search for environmentally friendly solutions that don't rely on fossil fuels. By switching to more suitable materials, plastic recycling may be greatly enhanced. Even after flawless waste separation by polymer type, the chain-level recycling is typically constrained by the reasonable tuning of the molecular-weight distribution or branching that produces the necessary attributes (for example, melt flow index, crystallinity). The most promising main chains, and polyesters are likely the most significant in this context, are those that allow for simple chemical assault. It is possible to recycle effectively at the monomer level or to rebalance the molecular weight distribution thanks to the chemically selective opening of the thermally highly stable ester bond. The fact that PET is the one commodity polymer with the most flexible and easily implemented recycling alternatives is at the core of its commercial success. Particularly, solvolysis offers a PET monomer recovery alternative that is energetically and economically viable but not for other common commodity plastics.

Improved and recyclable ion-conducting barrier materials for batteries may potentially benefit from the development of new, more environmentally friendly polyelectrolytes or ionomers with lower charge densities. Notably, versions made of polyester have already been documented. Understanding the physical behaviour of polyelectrolytes, in particular how they behave in the solution phase, is one of the most significant open problems from a theoretical perspective, and it has significant ramifications for our comprehension of life. The fields of polymer science and the biological sciences have traditionally strongly interacted. Start by considering the argument against Staudinger and his macromolecular theory that polymer crys-

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tals arise because their constituent (macro) molecules are substantially bigger than the crystallographic unit cell.

Only long later, when Watson and Crick's analysis of Rosalind Franklin's renowned "Photo 51" revealed the double helix in DNA crystals, was this issue finally addressed. Additionally, biological macromolecules have frequently been used as mesoscopic model materials to examine topics in polymer and colloid science. This especially applies to DNA, which can be observed at optical resolution and is monodisperse with a long persistence duration. Thus, a probe to see the reptation tube has been made using fluorescence-labeled DNA in a semi-dilute solution.

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CONFLICT OF INTEREST

There are no conflicts of interest.