练习七

1. As the word implies, polymers are extremely large molecules, sometimes called macromolecules to emphasize their very large size. The individual parts that combine to form them, monomers from the Greek mono, "one", join to each other in enormously large numbers to produce polymers with molecular weights ranging from the tens of thousands to millions of atomic mass units. Often the monomers unite to form an enormously long, linear molecular thread, very much like a long chain we might find in a hardware store. In other polymers the chains may be branched to various degrees, or they may be interconnected at occasional junctions, or so frequently that they form a web or even a rigid, three-dimensional lattice. In any event, a polymer is a substance composed of huge molecules, sometimes in the form of very long chains, sometimes as sheets, sometimes as intricate, three-dimensional lattices. A plastic, on the other hand, is a material that can be molded readily into a variety of shapes. All of today's commercial plastics are polymers, even though some of our most important polymers are not at all plastic.

2. **plastics** Materials that can be shaped by applying heat or pressure. Most plastics are made from polymeric synthetic resins, although a few are based on natural substances (e.g. cellulose derivatives or shellac). They fall into two main classes. *Thermoplastic materials* can be repeatedly softened by heating and hardened again on cooling. *Thermosetting materials* are initially soft, but change irreversibly to a hard rigid form on heating. Plastics contain the synthetic resin mixed with such additives as pigments, plasticizers (to improve flexibility), antioxidants and other stabilizers, and fillers.

3. Polymers comprise a large fraction of the total production of the chemical industry. Their macromolecular structure adds complexity to the study of relationships between molecular architecture, morphology and physical properties. As polymers continue to replace existing materials in certain applications, greater understanding is required at various levels, ranging from the molecular to the continuum. Chemical engineers contribute to the polymer field in numerous areas of activity such as polymer processing, polymer rheology, structure property relationships, polymer synthesis and characterization, and interactions among these different areas.

4. The structure and properties of polymeric materials derive ultimately from their molecular scale architecture and the manner in which the molecules respond to processing. Molecular simulation and applied statistical thermodynamics provide the means for detailed inquiry, and suggest avenues by which these interactions may be exploited for improved performance. Novel computer methods are being developed at MIT for the study of different polymer architectures and morphologies, from semi-crystalline solids to polymer micelles. Recent advances include the first accurate models of thermal expansion and elastic moduli of crystalline polymers, and methods to probe the molecular mechanisms responsible for relaxations in these materials. Experimental tools such as X-ray scattering and NMR spectroscopy are used in conjunction with theoretical studies to provide the molecular-level knowledge of polymer structure resulting from external processing influences such as fiber spinning and compression molding.

5. The actual linking of the monomers through covalent bonds occurs during polymerization, a chemical process easily divided into two broad categories: *condensation polymerization* and *addition polymerization*. The products are condensation polymers and addition polymers, respectively

6. In a condensation reaction two molecules combine with the formation and loss of another, smaller molecule, usually water or a simple alcohol. The general term condensation reaction probably originated as early chemists observed water or similar liquids forming droplets of condensate on the sides of flasks during this sort of reaction. Each of the condensing molecules contributes some portion of the smaller molecule being eliminated.

7. Despite the immense initial popularity of nylon, a condensation polymer, a different class of plastics dominates today's chemical economy. Addition polymers such as polyethylene and several of its close molecular relatives account for more than half of all the plastics currently produced in the world. These addition polymers form as their individual, unconnected monomers join together to form a polymeric chain in much the same way as people standing next to each other can form a human chain by holding the hands of those next to them.