CHAPTER II.4.2

Chemical and Biochemical Degradation of Polymers Intended to be Biostable

QUESTIONS

1. The two major mechanisms of chemical degradation of polymers in vivo are hydrolysis and oxidation. Given the following polymers, indicate whether they are susceptible to hydrolysis, oxidation or both processes. If they would be highly resistant to both processes, so indicate.
   - Poly(carbonate urethane)
   - Poly(ether urethane)
   - Poly(ester urethane)
   - Aromatic polyester, poly(ethylene terephthalate)
   - Polypropylene
   - Polyethylene (linear)
   - Polytetrafluoroethylene
   - Poly(dimethylsiloxane).

2. What are some common polymer functional groups susceptible to hydrolysis?

3. In the past, investigators have fabricated heart valves from “aromatic polyurethanes” which contain polyether, urethane, and urea functional groups. These devices were intended to last for several years in use, but have generally failed to perform for those periods.
   - What physical and chemical forces are acting on the heart valves in vivo?
   - What are the most likely mechanisms (physical and chemical) of degradation leading to failure of these devices? State at least three mechanisms.

4. As a materials scientist, you have experience with polyurethanes as biomaterials. Among the readily available commercial elastomers, they demonstrate the best combination of physical properties, but are susceptible to biodegradation, mostly through their polyether or polyester soft segments. You are charged with designing a biostable elastomer (polyurethane or otherwise).
   - Choose an approach to produce a chemically stable elastomer that retains reasonable physical properties for at least three years.
   - Describe five tests/analyses (in vitro and/or in vivo) which may be used to characterize this elastomer and confirm its potential stability.