Properties of Polymers Homework #2 Due on 06 May 2010

Questions from the Textbook

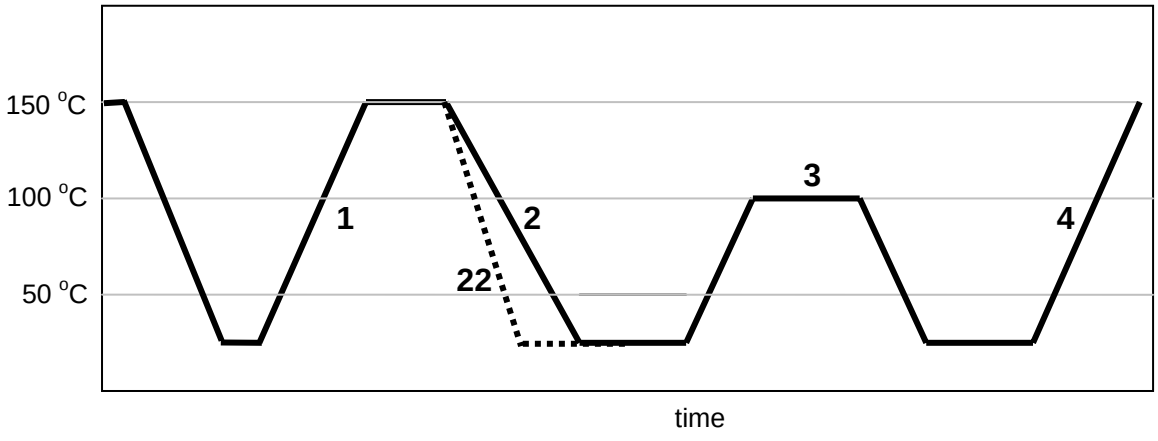
1. Do Problems 1, 2, and 5 of Chapter 5 on pp230-231 of the Textbook.

2. Do Problems 7, 8, and 16 of Chapter 6 on pp321-322 of the Textbook.

Questions from the exams taken earlier

1. Comment on each of the following statements. Tell if the statement is true, true under some condition, or totally wrong. Give your reasoning also.
   (a) Polyethylene terephthalate, a semicrystalline polymer, does not form complete amorphous state.
   (b) There is no atactic vinyl polymer that can form semicrystalline state.
   (c) For a given polymer chain, its freely rotating chain is larger than the freely jointed chain.
   (d) For a given polymer chain, end-to-end distance calculated taking account of excluded volume effect is larger than that calculated by RIS model.
   (e) A polymer chain in its amorphous state has the same dimension as in its unperturbed state.

2. A polyethylene sample is subjected to the thermal history given below, and a differential scanning calorimeter (DSC) recorded the heat flux.
   (a) Draw the schematic DSC thermogram for the process 1 and 2. Show exothermic and endothermic directions and name the peaks.
   (b) What do you call the process 3? What happens to the semicrystalline structure during that process?
   (c) Draw the schematic DSC thermogram for the process 4 in comparison to the thermogram for the process 1.
   (d) If you follow the process 22 instead of process 2, what happens to the semicrystalline structure of the sample?



3. (a) It is usually found that a polymer of high heat stability is also of low flammability. How would you explain it?
   (b) It is often found that the dielectric constant of one polymer (polymer A) is much lower than the other polymer (polymer B) at a high frequency, even though the dielectric constant of the two polymers were similar at a low frequency. How would you explain it?

4. Answer the following questions briefly.
   (a) Why is the temperature coefficient of chain dimension negative for polyethylene and positive for polyoxymethylene?
   (b) Give the Miller index of the fold surface of a solution-grown polyethylene lamellar crystal. The plane is of the largest area of the lamella surfaces.
   (c) What would be the result of a high Keith-Padden structure parameter, $\delta = D/G$, in terms of structure of the spherulite?
   (d) Which of Rouse model or reptation model explains the dynamics of polymer chain in amorphous state better? Why?

5. A polymer specimen is subjected to a uniaxial tension of 20 MPa. Young's modulus and Poisson's ratio of the polymer is 2 GPa (2000 MPa) and 0.4, respectively.
   (a) Express the stress in a matrix form.
   (b) Calculate the volume strain. Assume that volume strain is the sum of normal strains.
   (c) Estimate bulk modulus of the polymer.