CENTRE FOR POLYMER SCIENCE AND ENGINEERING

MAJOR EXAM PTL705 POLYMER CHARACTERIZATION

Part A   20 points

1. State the essential requirement for molecular weight determination by End Group Analysis? Give one limitation of the method   (2 points)

2. Calculate the reduced viscosity of a 0.5% solution (made by dissolving 0.25 g of polymer in 50 mL of solvent) where the time for solvent flow between two appropriate marks was 60s and the time of flow for the solution was 80 s.   (3 points)

3. Explain how to determine the crystallinity of a polymer sample from DSC

(3 points)

4. Explain how to distinguish between the following two monomers by a) IR and b) NMR

(4 points)

and
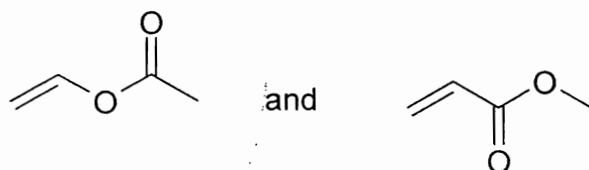
5. $C_8H_{18}O_2Si$ is a Group Transfer Reagent used in the Polymerization of α,β-unsaturated esters, ketones, amides, nitriles etc. Deduce its structure from the following data:

^1H NMR: δ 3.67 (s, 3H) 1.72 (s, 3H) 1.69 (s, 3H) 0.53 (s, 9H) ppm

^{13}C NMR: δ 148.2, 90.5, 56.2, 15.1, 14.9, 0.2 ppm.

(4 points)

6. Determine the structure of the following monomer with the Molecular Formula $C_6H_{11}NO$ from the data given below: (4 points)

^1H NMR: δ 5.26 (1H, D_2O exchange) 3.16 (t, 2H) 2.35 (t, 2H) 1.69-1.58 (multiplet, 6H) ppm.

^{13}C NMR: δ 179.5, 42.6, 36.9, 30.3, 28.9, 24.2 ppm.

Polymer Characterization

Part B   Major Test   Max Marks 30   29th November 2006

Note: Begin answer of each question from a fresh page. Blank spaces must be crossed out. Answers must be written neatly.

Q. No. 1 A typical x-ray patten is shown below. If, $F\Phi$ is 0.78. Calculate approximately the angle "Φ".   7

Q. No.2 A x-ray pattern is shown below. Obtain an approximate crystallinity. Draw similar curves for sample with half the crystallinity obtained.   7
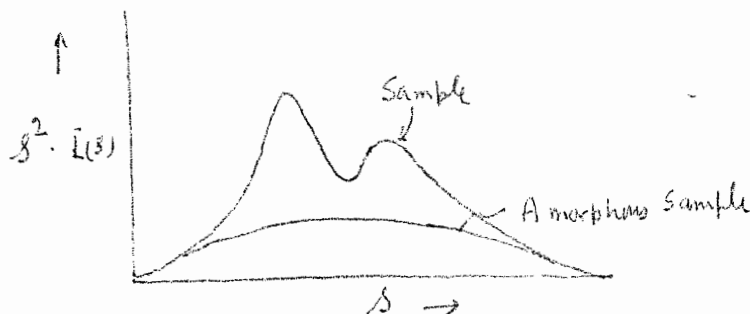
Q.No. 3 Elaborate the following statements(Correct, if the statement is wrong):
(a) Small angle x-ray scattering can be used to calculate average amorphous sizes.
(b) Damage of the sample by electron beam in SEM can be avoided.
(c) It is possible to obtain the direction of stretching in a mono-axial samples of say polyester films.
(d) Spherulitic growth rates can be obtained by optical microscopy.
(e)DSC can always give us a very reliable values of crystallinity.   10

Q.no. 4 A glass polyester composite sample with weight fractions of 50:50 has a 'DSG' density value of 1.70gm/cc. The density of glass and polyester resin be taken as 2.5gm/cc and 1.125gm/cc respectively. Is there a difference the prediced value and the calculated value,explain.   6

Useful expressions $f_\phi = \frac{1}{2}\left[3\langle\cos^2\phi\rangle - 1\right]$

$$\chi_c = \frac{\int_0^\infty s^2 I_c(s)\, ds}{\int_0^\infty s^2 I(s)\, ds}$$