ChE 891/2

Experimental Methods in Nanotechnology

Homework 7
Due 26 March 2008

1. The original nanoscale characterization technique is the intrinsic viscosity. One can write the equation to determine the intrinsic viscosity using the Huggins equation as

$$\mu_{sp}/c = [\mu] \{1 + k_H [\mu] c\} \quad (1)$$

One can also use the Kramers form

$$\ln(\mu_{rel})/c = [\mu] \{1 + k_K [\mu] c\} \quad (2)$$

where μ_{rel} is the relative viscosity defined as the ratio of the solution to solvent viscosity (i.e. $\mu_{sp} = \mu_{rel} - 1$). Determine the relation between k_H and k_K. *Hint*: Take eq (1) above and write it in terms of $\mu_{rel} = \ldots$, then take the natural logarithm of both sides of the equation and use a series expansion to determine the relation between k_H and k_K.

Here is data for 110 kD linear polystyrene in benzene at 35°C, determine the intrinsic viscosity, k_H and k_K and ensure the above relation between them is valid.

c (g/mL)	μ_{sp}/c (mL/g)
0.0200	66.9
0.0108	57.5
0.0058	55.5
0.0031	53.0

2. Make an array of 51 random numbers for times from zero to 50, the random numbers will represent the intensity in a dynamic light scattering experiment. Determine the autocorrelation function for delay times of 1, 2, 3, 4, 5 and plot the auto correlation function as a function of delay time. Do you see any trend? Recall the reason why the autocorrelation function is used in dynamic light scattering and state why or why not the diffusion of nanoparticles has any correlation in the intensity fluctuations.

3. Find papers in the literature where they have used dynamic light scattering to characterize nanoparticles. Give a table summarizing their results. Did they check for a concentration effect in the hydrodynamic radius? Under what conditions did they do the measurements? Do you expect a concentration effect?

Please give the references to any archival journal or book in your homework solution.