

## Experimental Methods in Nanotechnology

Final Exam  
30 April 2008

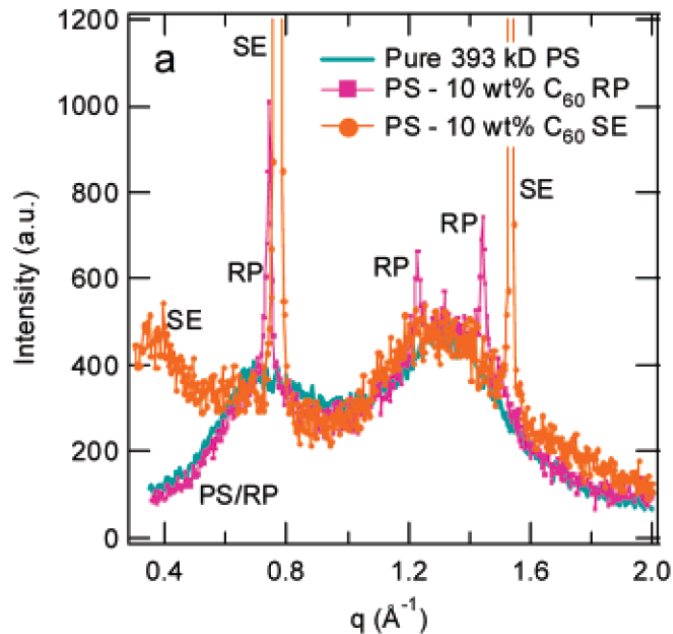
This is an open notes exam, you may bring in notes from the class as well as homework solutions.

1. In dynamic light scattering you measure the autocorrelation function of the scattered light which is then fitted to a function resulting in a measure of the diffusion coefficient. Suppose you have this data:

time (s):	0	1	2	3	4	5	6
Intensity (a.u.)	6	5	4	3	2	1	0

Determine the autocorrelation function of this data for a delay time of 2 s.

2. Below is a plot of scattered X-ray intensity versus wave vector determined in a wide angle X-ray scattering instrument. This data is for a polystyrene sample filled with fullerenes where scattering occurs from phase separated fullerenes. A  $C_{60}$  fullerene is approximately 0.7 nm in diameter, determine the size of the scattering objects, and estimate the number of fullerenes in each object, for the SE sample with particular mention of the largest object that could be characterized with this technique. The data are from A. Tuteja, P. M. Duxbury, M. E. Mackay, *Macromolecules* **40**, 9427 (2007).



- Describe why the scattering length varies widely for neutron scattering using quantum mechanics.
- Discuss the causes of incoherent neutron scattering.
- Describe why an atomic force microscope can give such high resolution images of a surface.
- Discuss why neutron scattering can be considered as scattering from a point object while X-ray and light scattering can not.
- Define the scattering length, scattering cross-section and scattering length density.