Action D43

Colloid and Interface Chemistry for Nanotechnology

D43 Training School "Fluids and Solid Interfaces"

Tutroial: Scattering from liquid-Liquid

1. Calculate the scattering length density, ρ for a silicon substrate and hence a value for its critical angle θ_c at a wavelength of 5.0 Å.

[Properties of Si: density = 2.33 g cm^{-3}; atomic weight = 28 g mol^{-1}; neutron scattering amplitude = 0.42 × 10^{-12} cm].

2. Calculate the difference in the scattering length densities for Iron, for neutron spin aligned parallel and antiparallel to the Fe magnetic moment.

Neutron scattering length, b	9.45 fm
Magnetic moment	2.2 μ_b
Density	7870 kg m^{-3}
Atomic mass	55.845 g mol^{-1}

C = 2.695 fm μ_b^{-1}

3. Scattering wave vector is defined as;

$$Q = \frac{4\pi \sin\theta}{\lambda}$$

Derive an expression for the resolution $\frac{\Delta Q}{Q}$.

4. A 20 Å neutron and Airbus A380 leave Sofia airport at the same time bound for Chicago by the same route. Assuming Airbus covers 5600 kilometre in 9 hours, which arrives first at Chicago and by how much. (You may neglect the finite lifetime of neutrons!)

5. What is the energy of 5 Å neutrons in electron-volts, eV?

6. Calculate the theoretical transmission of 1 mm thick layer of water.

$$T(\lambda)\exp[-N \times t \times \sigma_{total}(\lambda)]$$

Where t is the path length (0.01 cm) and σ_{total} is total cross-section.

7. Small group Exercise:

   Computer based analysis of neutron reflectivity data for protein friendly surfaces. This involves analysis of neutron reflectivity data to probe the resistance of a poly (ethylene glycol) (PEG) coated silicon surface to the adsorption of the model protein bovine serum albumin (BSA) from buffered aqueous solution. [**Please see the additional information provided**]