1 Fundamentals

1.1 Nanoparticles in medicine

1.1.1 Polymeric colloids

1.1.1.1 Functionalization for protein binding

1.1.1.2 Polymerization consequences (initiator, co-monomer, surfactants...)

1.1.2 Liposomal nanocarriers (formation for amphiphilic lipids)

1.1.2.1 phospholipid bilayer (typical molecules HSPC, DPPC, cholesterol, PEG...)

1.1.2.2 polydispersity control (extrusion, paper w/ Zoltan)

1.1.2.3 Drug carrier, SSLs (stealth function, bilayer stabiliy, filling)

1.1.3 Physicochemical characterization

1.1.3.1 Dimensional metrology and traceability

1.1.3.2 Characterization tools

1.1.3.2.1 Single-particle (AFM, TEM, SEM, TSEM...)

1.1.3.2.2 Ensemble (DLS, DCS, SAXS)

1.2 Small Angle X-ray Scattering (SAXS)

1.2.1 Physical Process

1.2.2 Evaluation of the scattering intensity (Form factor * S(q) , electron density, number of colloids)

1.2.2.1 What is q?

1.2.2.2 Modelling

1.2.2.2.1 Sphere (Gudrun polymeric colloids)

1.2.2.2.2 Core-shell (interface effects???)

1.2.2.2.3 Vesicle model (5 gaussian) ????

1.2.2.2.4 Inclusion of background ??? (a+b*q^-4)

1.2.2.3 Guinier approach (deviation when using few points, polydispersity...)

1.2.3 Contrast variation (solvent variation, ASAXS...)

1.2.3.1 Isoscattering point

1.2.3.1.1 Polydispersity and elipticity smearing (simulation, calculation)

1.2.3.2 Basic functions approach

1.2.3.2.1 Shape factor

1.2.3.2.2 Guinier rule

1.2.3.2.3 I (0) for polydisperse systems

2 Experimental setup

2.1 BESSY II

2.2 FCM Beamline

2.2.1 Transmission measurements (calibrated diodes)

2.3 SAXS

2.3.1 Pilatus detector (high dynamic range, noise free...)

2.3.2 HZB SAXS setup

2.3.2.1 distance calibration (10^-4 uncertainty)

2.3.3 Radial integration and error propagation

2.3.4 Absolute intensity calibration

2.3.4.1 Flux monitor (thin diode)

2.3.4.2 Detector efficiency (pilatus, thin diode)

2.4 Continuous contrast variation

2.4.1 Filling of capillaries (galden at bottom, reference layer)

2.4.1.1 Capillary homogeneity (Hilgenberg)

2.4.2 Calibration of solvent density and finding of main axis

2.4.3 Limitations

2.4.3.1 Density range (sucrose, fructose, iodixanol)

2.4.3.2 Background, induced aggregation (heavy salts)

2.4.3.3 Comparison to SANS / RSoXS in polymeric Nps (H. Abe, 2006)

3 Contrast variation in SAXS with the density gradient technique (1st paper)

3.1 Materials and methods

3.1.1 Particle and chemicals

3.1.2 Diffusion time and calibration height (sucrose mass fraction formula)

3.2 Continuous contrast variation in SAXS on PS-PMMA nanoparticles

3.3 Model dependent evaluation

3.3.1 Core-shell form factor fit

3.4 Model-free approach to contrast variation data

3.4.1 Isoscattering point

3.4.1.1 Relative standard uncertainty

3.4.2 Guinier Region analysis

3.4.2.1 Average electron density

3.5 Summary