ESRF	**Experiment title:** Phase behavior and aggregation kinetics of OEG-coated gold colloids in protein solutions	**Experiment number**: SC-2625
Beamline: ID2	**Date of experiment**: from: 13th March. 2009 to: 16th March. 2009	**Date of report**: 04 May 2009
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Report:

Self-assembled monolayers (SAMs) with oligo-ethylene-glycol (OEG) termination are of great importance in biomedical applications due to their protein resistance, as first reported by Prime and Whiteside in 1993 and now used routinely in biomedical applications [1,2]. In this project we propose to study the protein resistant SAMs with OEG termination on gold nanoparticles *in-situ* using small angle x-ray scattering and the interactions and aggregation kinetics of colloid with model globular proteins of different size and net surface charge such as ferritin, bovine serum albumin (BSA), ovalbumin and lysozyme.

One of the interesting observations from our previous study of this system is that decorated colloids lose their stability and form aggregates upon adding protein above a critical concentration, [3], which can be interpreted in terms of an attractive interaction between gold colloid caused by the depletion force. The range of the potential depends on the interactions of both the BSA and coated colloid particles [3]. Kinetics study on the depletion induced colloid aggregation indicates a transition from reaction-limited aggregation (RLA) to diffusion-limited aggregation (DLA) [4]. Further study on the stability of the protein-colloid system indicates that the stability strongly depends on the nature of the added salts, which follows the Hofmeister series [5]. For better understanding the interactions in the protein-colloid two-component system, we have studied the protein-protein interactions in solution as a function of protein, ionic strength and ion valency [6,7].

In this beamtime, we aimed to distinguish the phase staus of the colloid aggregates induced by depletion effect and screening effect. In the first case, we studied the aggregation of Au nonoparticles (AuNPs) by adding salt. Due to the screening effect, the effective interaction between a pair of AuNPs becomes attractive, which causes the aggregation.

The SAXS measurements at the ESRF (Grenoble, France) were performed on the beamline ID02 with sample-to-detector distance of 2 m [8]. The wavelength of the incoming beam is 1.13 nm (11keV), covering a q range of 0.05 to 2.1 nm^{-1}. The data were collected by a high sensitivity fiber-optic coupled CCD (FReLoN) detector placed in an evacuated flight tube. The protein solutions were loaded using a flow-through capillary cell (diameter ~ 2 mm; wall thickness ~ 50 μm). The radiation damage was checked with 10 successive exposures of 0.1 s. The incident and transmitted beam intensities were simultaneously recorded with each SAXS pattern with exposure of 0.3 s. The 2D data were normalized to an absolute scale and azimuthally averaged to obtain the intensity profiles, and the solvent background was subtracted.

Figure 1 presents the in situ SAXS data for citrate stabilized AuNP (20 nm) with addition of 0.8 m $MgCl_2$. With increasing time, we observe a decrease of scattering intensity in the low q region ($q < 0.13$ nm^{-1}) as well as an increase of intensity in the q range between 0.13 $nm^{-1} < q < 0.3$ nm^{-1}. This change indicates the formation of colloid aggregates. SAXS data for colloidal aggregation under different conditions are under investigation.

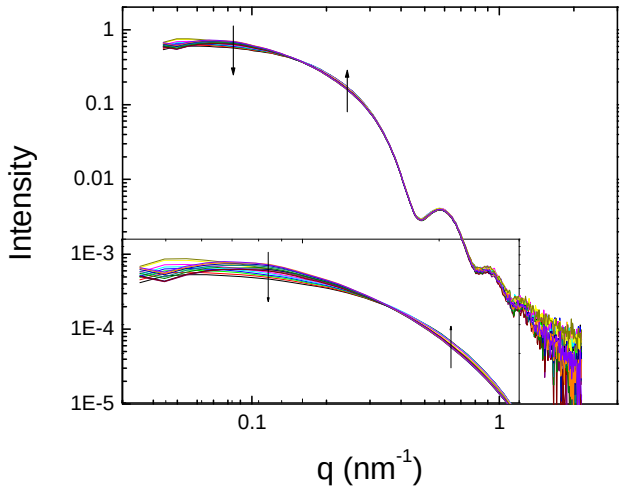

Figure 1. Time resolved SAXS profiles of Au20 with 0.8 mM $MgCl_2$

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