ESRF	**Experiment title: A SAXS study of oligonecleotide programmed self-assembly of conductor-semiconductor-insulator nanoparticles in solution.**	**Experiment number**: CH-676
Beamline: ID01	**Date of experiment**: **from:** 14 July 1999 to: 17 July 1999	**Date of report**: 19 August 1999
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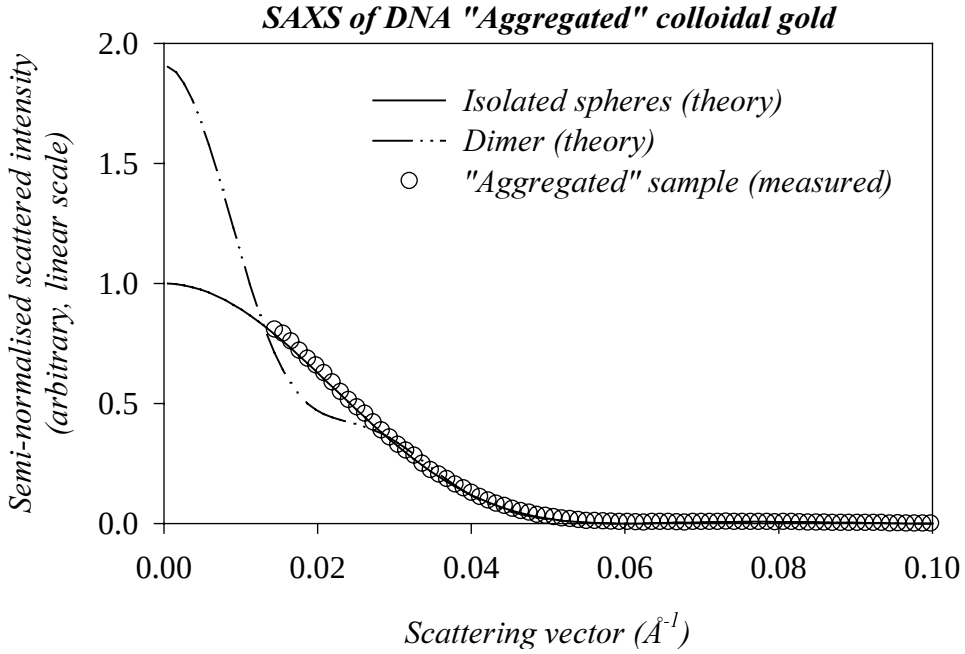
Report:

Chemisorption of suitable biotin analogues at the surface of a nanocrystal provide a mechanism for the selective binding and recognition of streptavidin in solution by the nanocrystal. At monolayer coverage, the sol is stable against aggregation, from cross-linking, and the resulting particles are now programmed to recognise biotin in solution. Addition of biotin derivatised DNA oligonucleotides should then result in a particle programmed to recognise the complimentary ogigonucleotide sequence. This technique has the advantage of allowing a large set of different sequences and particles to be combined comparitively easily, further the high binding constant for biotin to streptavidin ensures that the oligonucleotide sequence and the particle are irreversibly and rapidly bound.

The first experiment in establishing this route, is the aggregation of monolayer coated nanocrystals by addition of biotin derivatised DNA duplexes, followed by disaggregation on melting of the DNA duplex.

The low electron density difference between the protein (streptavidin) and the solvent (water) means that visible light scattering is the most appropriate technique for determination of protein binding. DLS measurements at EMBL showed that addition of a monolayer of streptavidin increased the average particle radius by 4 nm (consistent with the dimensions of streptavidin). Further, addition of the biotin derivatised DNA duplex at ½ monolayer coverage had the net effect of increasing the average particle/aggregate radius by more than a factor of 5, providing strong evidence for aggregation via this route. Conclusive evidence, requires measurement of the scattering function of the gold particles in the aggregate by SAXS.



Shown below are the results of SAXS measurements of these “aggregated” samples of colloidal gold

Comparison of the measured scattering function with theoretical calculations would seem to contradict the DLS measurements of these same samples. The exact reason for this has yet to be established.

Several key factors have since been determined and remain to be addressed: the gold colloid does not seem to “travel” (subsequent measurements should thus be conducted with colloid prepared on site); the DNA duplex samples had partially melted in the process of bringing them on site, the annealing process is quite time consuming and hence the duplex solution used was only ~60% duplex (subsequent measurements will require either annealing of the DNA sample on site at least two days prior to the experiments or a winter schedule – T_m ~ 35°C); subsequent measurements would also benefit from access to lower scattering vectors (esp < 0.002 $Å^{-1}$).