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Aerosol Model Nanoparticles for Protein/Biomolecule Corona Determination in Physiological Buffers - Possible Means of Determining Particle Toxicity and Fate in Humans

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84) Aerosol model nanoparticles for protein / biomolecule corona determination in physio-logical buffers – possible means of determining particle toxicity and fate in humans.

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Awareness of health effects due to nanoparticle exposure has continuously increased over the last decade. The primary route of exposure is by air, as particles deposit in the respiratory tract. Due to the special properties of nanoparticles, such as a high surface area to mass/volume ratio, concern has been raised with regards to their potential effects in biological systems. In recent years the particles interaction with biomolecules has been acknowledged as crucial for the understanding of particle toxicity (Lynch, 2009). When biomolecules bind to the particle surface a dynamic protein/biomolecule corona is created (Cedervall, 2007). The protein corona is dependent on the surface chemical properties, the size and morphology of the particles. The protein corona is believed to be important for the biological effects of nanoparticles.

Figure 1 Gold nanoparticles generated by high temperature evaporation condensation (HT). To the left sintered 60 nm nanoparticles and to the right 60 nm dme agglomerates.

In this work we present a method to investigate the composition of the biomolecule/protein corona on model nanoparticles in three different physiological fluids bovine serum albumin (BSA) porcine serum and porcine lung fluid. Gold nanoparticle (AuNP) agglomerates and spheres (60 nm dme) were generated by high temperature evaporation condensation (HT), see figure 1. To generate the spheres agglomerates where sintered at 400°C. Both spheres and agglomerates where characterized online by tandem differential mobility analysis (T-DMA) and aerosol particle mass analysis (DMA-APM) (Ehara, 1995).

Both particle types, spheres and agglomerates, were deposited onto solutions of bovine serum albumin (BSA), porcine lung fluid and porcine blood serum using an electrostatic precipitator (ESP). AuNPs in suspension with BSA were characterized with dynamic light scattering (DLS) on selected time-intervals (h to days). AuNPs were also deposited directly into porcine lung fluid and blood serum. Using sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) the protein corona was determined for AuNPs deposited into lung fluid and blood serum.

DLS data indicate that particle-biomolecule complexes had formed in suspension for AuNP depositions in BSA with sizes of approximately 160 nm. The DLS signal could be observed over the course of several days for particles deposited into BSA.

Results from SDS-PAGE indicate that the protein corona is different between agglomerates and spheres in porcine blood plasma (Figure 2). The result also indicates that the corona is different between particles deposited into lung fluid and blood serum.

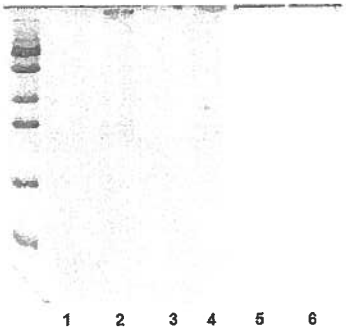

Figure 2. Results from SDS PAGE for gold nanoparticles mixed with porcine blood. 1 and 2 show the corona signature for spherical AuNP in full plasma and 10 times diluted respectively, 3 and 4 show corona signature for agglomerates in full and 10 times diluted plasma respectively. Bands 5 and 6 show the background signature of 10 times diluted and full blood plasma respectively.

In conclusion: We have shown that the protein / biomolecule corona can be studied using model particles generated in aerosol phase. Also, the observed corona is different between particles administered to porcine blood serum and lung fluid.

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