Lecture: nanotoxicology / nanobiotechnology

Nanotoxicity: application of atomic force microscopy and novel nanoparticle measurement technology

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Within the field of scanning probe microscopy, atomic force microscopy (AFM) is extensively used in a wide range of disciplines such as life science, solid-state physics, and materials science. The AFM has evolved into an imaging method that yields structural details of biological samples such as proteins, nucleic acids, membranes, and cells in their native environment. AFM is a unique technique for providing subnanometer resolution at a reasonable signal-to-noise ratio under physiological conditions. As a result of continuous developments in sample preparation, imaging techniques, and instrumentation, AFM is now a companion technique to X-ray crystallography and electron microscopy (EM). It complements EM by allowing visualization of biological samples in buffers that preserve their native structure over extended time periods. AFM has been used in various bio-medical applications including the testing of cellular toxicity of nanoparticles and carbon-nanotubes. Complementary to AFM we introduced recently novel particle analysis technology allowing reproducible measurements of nanoparticle size, aggregation, and zeta-potential. Reliable particle size and zeta potential results help ensure top-quality emulsions (such as fat particles in milk) and dispersions (such as silicon dioxide particles in toothpaste) for foods and personal care products. With their high sensitivity to small particles, the newly introduced technology is ideal for measuring drug suspensions, protein aggregations and agglomerations, liposomes, and intravenous emulsions particularly relevant for pharmaceutical analysis and quality control. In summary, the presented technology allows to characterize the physico-chemical effects of nanomaterials on biological systems including cell samples and tissue samples efficiently, rapidly, and very accurately. Current EU research projects and project proposals deal with carbon nanotubes and nanoparticles toxicity analysis using novel and validated technologies.

References

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