UC DAVIS MATERIALS SCIENCE AND ENGINEERING

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Single nanoparticle analytics: from viruses via exosomes to drug carriers

Next generation drug-delivery vehicles aimed to carry biological drugs, such as proteins or nucleic acids, are often designed to mimic how natural biological nanoparticles, such as viruses and exosomes, transfer genetic information between cells *in vivo*. Due to the large heterogeneity of nanoparticles irrespective of whether they are of biological or artificial origin, it is crucially important to advance analytical instrumentation to complement ensemble averaging methods with single nanoparticle analytical approaches.[1] A large set of tools with single-nanoparticle sensitivity is now available, to which we recently contributed a concept that enables simultaneous fluorescent and scattering-based label-free imaging of surface-bound biological nanoparticles [2]. Examples will be shown that illustrate the use of this scattering microscopy concept i) to investigate supported lipid bilayer formation, ii) for label-free measurements of protein binding to individual liposomes, iii) to characterize DLVO-controlled non-specific interactions at cell-membrane mimics,[3] and detergent free enrichment of pre-defined membrane proteins in crude cell membranes.[4] By using a two dimensional fluid supported lipid bilayer, to which biological nanoparticles are directly anchored and imaged, we have also developed a new means to simultaneously determine both nanoparticle size and fluorescence / scattering intensity,[5] which may potentially offer flow-cytometry-like sorting based on distinct features of individual nanoparticles. This 2D flow nanometry concept can also be used to quantify the valancy of nanoparticle binding to cell-membrane mimics.[6] These new analytical possibilities will be discussed in the context of improved characterization of individual biological nanoparticles of diagnostic and therapeutic significance.

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Bio: PROFESSOR HÖÖK develops surface-based bioanalytical sensors, with special emphasis on studies of cell-membrane mimics and biological nanoparticle analytics with emphasis on viruses, lipid nanoparticles and exosomes for medical diagnostic and drug-discovery applications. Focus is presently put on microfluidic platforms for detergent-free separation of cell-membrane components in native supported lipid bilayer, new means to improve characterization of individual biological nanoparticles and single-molecule methods for improved drug discovery. FH was in 2012 awarded the Göran Gustafsson prize in Physics by the Royal Swedish Academy of Sciences (KVA), is since 2015 member of The Royal Swedish Academy of Engineering Sciences (IVA) and was in 2019 awarded a prestigious Wallenberg Scholar for free research.