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Abstract

Plasmonic Detection of Particled Analytes: A Play between High Analytical Performance and Fundamental Limitations †

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Abstract: A development of sensors for selective detection of large (or particled) analytes, such as natural and engineered nano- and microparticles is a new challenge of analytical chemistry. Their detection is complicated by very high sensitivity requirements (in most cases in fM - aM particle concentration range), slow diffusion and non-equilibrial detection conditions, intensive adsorption to most surfaces and trend to aggregate. Recently an application of wide field surface plasmon resonance microscopy combined with computer assisted image analysis (WF-SPRM) for detection of large analytes was reported. This new technology provides a real-time detection of interaction of single nanoparticles with sensor surface. A number of the nanoparticle–surface binding events per time characterize volume concentration. A large monitored surface area of the sensor surface allows one to detect hundreds of events in each frame or totally up to a million particles on the sensor surface; this leads to very high dynamic range in the concentration scale. Linear dependence between image intensity and particle size allows one to get histograms of particle size distribution. To determine chemical composition of single nanoparticles separately, the WF-SPRM was used in combination with electrochemistry: electrochemical conversions lead to the change in the particle refractive index while the value of the applied potential of this conversion characterizes material of the particular nanoparticle. Another application field of WF-SPRM comprises surface processes leading to the formation of new nanoparticles, e.g., electrochemical nucleation. Fundamental limitations in the development of analytical techniques for large analytes will be also discussed.

Keywords: nanoparticles; bacteria; viruses; exosomes; surface plasmon resonance microscopy; large analytes; particled analytes