

GOLD NANOPARTICLES FOR SURFACE ENHANCED INFRARED ABSORPTION STUDIES OF PROTEINS

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Gold nanoparticles (AuNPs) have exceptional properties which have promoted their use in many fields such as biomedical imaging and diagnostic tests, biological applications, as catalysts, and for applications taking advantage of their enhanced optical properties. The vibrational absorption of molecules adsorbed on or present near nanostructured noble metal films may be enhanced by a factor of 10-1000 times.

Infrared (IR) spectroscopy is sensitive to protein structure and structural changes via vibrational resonances originating from the polypeptide backbone or side chains¹. Different approaches developed for the surface enhanced infrared absorption (SEIRA) determination of proteins are presented. Bare AuNPs have been synthesized from tetrachloroauric acid solution using steel or stainless steel as solid reducing agent². SEIRA using an ATR configuration has been used to analyze protein bovine serum albumin (BSA) adsorbed onto these bare AuNPs (Fig. 1). BSA has a high affinity towards AuNPs due to external thiol functions available for conjugation to the AuNP surface³. Consequently, SEIRA studies take advantage of the affinity of the protein to bare AuNPs directly synthesized inside the ATR cell, which are present within the evanescent field at the ATR crystal surface⁴. The absorbance of BSA onto AuNPs deposited at the Si waveguide is distinctly enhanced vs. bare Si, thus improving the sensitivity of the measurement.

On the other hand, boron doped diamond has been modified with such AuNPs for the investigation of BSA films using a combined atomic force microscopy-infrared absorption-electrochemistry (AFM-IR-ATR-EC) setup⁵. SEIRA effect was induced in the water absorption bands during the synthesis of the AuNPs⁶, which could be correlated with the size, shape and density of the particles, as measured with the AFM. Films of globular and fibril BSA were next deposited on the resulting surface for their optical and electrochemical analysis.

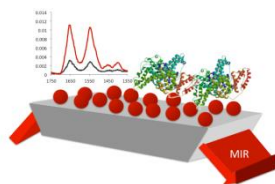


Figure 1 Bare AuNPs for surface enhanced infrared spectroscopic studies on bovine serum albumin.

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