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. Bare AuNPs have been synthesized from tetrachloroauric acid solution using steel or stainless steel as solid reducing agent [1, 2]. Photoenhanced adsorption of water on AuNPs has been employed for in-situ monitoring of the synthesis of bare AuNPs via surface enhanced infrared absorption attenuated total reflection spectroscopy (SEIRA-ATR) [3].

Bare AuNPs produce an enhancement in the Raman spectrum of e.g., carboxylated single walled carbon nanotubes (c-SWNTs) [4]. On the other hand, SEIRA using an ATR configuration has been used to analyze protein bovine serum albumin (BSA) adsorbed onto these bare AuNPs (Fig. 1). Bare gold nanoparticles forming the SEIRA-active substrate were synthesized in-situ inside the ATR compartment taking advantage of the stainless steel walls of the liquid cell inherently acting as reducing agent. BSA has a high affinity towards AuNPs due to external thiol functions available for conjugation to the AuNP surface [5]. Consequently, SEIRA studies take advantage of the affinity of the protein to bare AuNPs present within the evanescent field at the ATR crystal surface. The absorbance of BSA onto AuNPs deposited at the Si waveguide is distinctly enhanced vs. bare Si, thus improving the sensitivity of the measurement. Furthermore, it was shown that the presence of an AuNPs layer does not affect the secondary structure of the protein.

Last but not least, alternative gold nanostructures such as gold nanostars [6] are currently being investigated for surface enhanced vibrational spectroscopy applications. Gold nanostars are immobilized onto a silicon wafer or silicon waveguide via a gold layer and thiol-functionalized polyethylene glycol (PEG) for further application in SERS or SEIRA based analyses.

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

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