ABSTRACT

The interaction-mechanism of bio-organic molecules with metal nanostructures has been a fascinating topic of research for physicists. The last few decades witnessed the extensive use of biomolecule-conjugated metal particles in medicine and biology. In this thesis, we have addressed, to a certain extent, various aspects of metal-molecule interactions using Raman and optical absorption spectroscopic techniques.

In the first part, we present the light induced dipolar response of gold (Au) nanorods on anisotropic organic molecules. The effects of (a) varying concentrations of the added organic molecules, (b) varying aspect ratio of gold nanorods and (c) orientation of the adsorbed molecules, on the metal surface on their vibrational resonance frequencies have been addressed. The reason for different behavior of organic molecules, with aromatic or alkyl groups, in Au colloidal solution has been discussed.

The next part of the thesis investigates the interaction of silver (Ag) nanoparticles, spherical in shape, with two different biomolecules, a protein [lysozyme (Lyz)] and an enzyme [(–)-epigallocatechin gallate (EGCG)]. Our experimental results identify the specific amino acid residues of the protein involved in the interaction with metal particles. Interestingly, it is found that the part of the protein molecule known to have higher bio-activity, remains unaffected by metal-protein interaction. Later, it has been shown that Lyz conjugated Ag (LCS) particles can be used as a carrier for EGCG enzyme, a molecule which is known for its anti-cancerous and anti-bacterial activities. These observations can provide us a key to potential applications of LCS particles as biosensors and also in targeted drug delivery.

Keywords: Metal nanoparticles, Raman spectroscopy, Optical absorption spectroscopy