



Surface Enhanced Raman Scattering Studies: A New Spectroscopic Tool

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Raman scattering is obtained due to the fact that molecules themselves are vibrating at frequencies corresponding to various normal modes of motion. This characteristic Vibrational frequency can mixed with exciting light to form sum and difference frequencies in the scattered radiation. The measure of these shifts reflects the characteristic vibrations of the molecule and may be utilized as a complement to infrared spectroscopy molecules adsorbed on some type of rough surface gives rise to a Raman scattering several million times more intense than what one would expect for a molecule that is free in a solution. This effect is called surface enhanced Raman Scattering (SERS).

SERS Spectroscopy has been established as a powerful method for elucidating. The structure of molecules adsorbed on metal-electrolyte, Metal vacuum and metal – solid interfaces 1-4. SERS is a new type of molecular light scattering in which proximity of the molecule to the metal surface leads to an amplification of the molecularly scattered light.

The precise manner in which a molecule is involved in the processes is left somewhat speculative. As the molecule approaches the surface, there are both physical and chemical forces through which they affect each other. A molecule can be adsorbed on the metal due to dipole interaction and it is known as physisorption. A second interaction is related to the possible creation of weak chemical bond between the molecule and metal. This occurs if the molecule has an electron rich group such as a lone pair of electrons in a nitrogen.

Generally the chemisorbed molecules are more strongly bound to the surface than those that are physisorbed but in either case the interaction will be weak when compared with chemical bonding. All molecules to some extent may be physisorbed but only certain groups like nitrogen, Carbonyl can be chemisorbed.

The surface coverage and molecular orientation of species adsorbed from solution on to a metal surface, depend on the applied potential at the surface. Neutral molecules tend to adsorb more readily at surface potentials near the potential of zero charge (PZC), whereas charged species may either adsorb directly on surfaces of opposite charge or adsorb on similarly charged surface via strongly adsorbed counterions. The surface orientation of complex molecules is often difficult to predict, because solvophilic or solvophobic interaction may be just as important as adsorbate surface interactions in determining adsorbate orientation.

The theoretical understanding of the mechanism complete it is generally agreed that in any given adsorbate substrate system several enhancement mechanisms may be operating and however, the relative importance of the various mechanism is somewhat controversial.

The laser spectroscopy group of school of physics has developed a Raman scattering arrangement. The major constituents of the set up are source of monochromatic radiation, an appropriate sample compartment a system for the dispersion of scattered radiation, a detector and a read out device the 90° Scattering geometry is used in all our measurement. Since various SER studies have established silver as the effective substrate, we have used in in the form of colloids, silvers SOI, prepared by us has a very strong and sharp absorption band at 390nm. The concentration of metabolic dye solution is approximately 10^{-3} mole per litre the sample solution and the silver sol are mixed in the ratio 1:1

In our SERS study we have chosen some amino and hydroxyl derivatives of anthraquinones which have electron donating groups like amino and carbonyl groups for adsorption. The existence of two different carbonyl groups seem to be the reason for the presence of two dens in the carbonyl stretching frequency region the carbonyl oxygen which is charged partially negative due of the charge transfer between the amino and the carbonyl groups and pair of electrons of the nitrogen atoms form good binding sites for the surface adsorption on the silver surface thus the adsorption of the molecule through the carbonyl group in the 9th position led to the presence of two frequency in the spectrum the new bands observed for C-N and N-H Stretching vibrations also indicate that these molecules are adsorbed through their coordinating sites.

In another case a molecule (with adjacent hydroxyl group) has coordinating site (C-O) the hydrogen bound formation between (C-O) and O-H group does not allow the molecule to get adsorbed through this site here, These molecule may be adsorbed flat on the top of the metal surface because of the planer structure the interaction between the metal and the adsorbed molecule is strengthened during vibration so. The link of the molecule with surface cannot be destroyed. The change transfer between the adsorbate and the substrate is more pronounced. so atomic species at colloidal and electrochemical environments showed that the adsorbate orientations is sensitive to same out and in plane bending modes. The out of plane vibrations play a dominant role in the SERs spectra of planar molecules for flats orientation on metals surfaces CH - Vibration confirms "Flats on" Configuration.

The richness of spectroscopic information surface selectivity sensitivity of SERS provides impetus for using it to solve problems in analytical chemistry. Thus is SERS can provide unique insight for diverse chemical problems at complex interfaces and interfacial Processes.

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