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Research Article

SURFACE PLASMON RESONANCE STUDY OF LANGMUIR-BLODGETT FILMS OF STEARIC ACID

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ABSTRACT
Stearic acid is one of the commonly studied fatty acid. It exhibits interesting behavior on surfaces. The Langmuir Blodgett films of stearic acid were fabricated on solid substrates. We have developed a surface plasmon resonance (SPR) instrument in the Kretschmann configuration. The change in SPR angle due to molecular specific interaction is potentially employed for sensing application. In this paper we report our studies on SPR of stearic acid deposited on solid substrates. We find a significant change in the resonance angle.

Key Words: *Surface Plasmon Resonance, Langmuir – Blodgett Film, Stearic Acid, Kretschman Configuration*

INTRODUCTION
Surface Plasmon is a collective oscillation of electrons at a metal-dielectric interface. This can be generated in various methods like using atomic beam or electromagnetic wave. Commonly due to convenience, electromagnetic wave is used to generate the surface Plasmon in very metallic film employing a coupling prism. Surface Plasmon generation is sensitive to the interfacial refractive index which enables it as a sensor for molecular species detection (Schasfoort and Tudos, 2008).
Kretchsmann configuration is a method in which a coupling prism surface is in contact with the gold film of thickness of about 50nm. The outer surface of the gold film will be in contact with the chemical component to be analysed. At the surface Plasmon resonance, the incident wave vector is equal and opposite to that of the wave vector of the surface Plasmon wave in the metallic film. Such condition enables to determine the change in the refractive index due to the adsorption of the species at the metal-dielectric interface. The shift in the resonance angle is very sensitive to the change in refractive index at the metal-dielectric interface and thereby postulates the mechanism for molecular species recognition by the detection of change in the resonance angle (Schasfoort and Tudos, 2008).

MATERIALS AND METHODS
We have developed the SPR instrument for molecular species recognition. This is shown in Figure 1.
We have employed a BK7 glass hemispherical prism mounted on a rectangular aluminium block which is fixed on a translation stage enabling horizontal and vertical motions for a range of one inch each. Here in this configuration, a motor-controlled mirror is used to change the angle of incidence. The source used is a laser (Newport) of wavelength 635.8 nm and 3mw of power.
A photodiode of diameter 1inch is used to as detector. The data is acquired through a digital multimeter (KEITHLEY-2000) which is computer interface via Kiethley GPIB (KUSB -488A).
A solution of stearic acid (Sigma-Aldrich) in HPLC grade chlorofrom of concentration 1mg/ml was prepared. The solution of stearic acid was spread using a micro syringe (Hamilton) on the Millipore Milli-Q water having resistivity ≥ 18.2 MΩ-cm. The Langmuir-Blodgett (LB) technique (Gaines, 1966) was employed to transfer film of the stearic acid onto hydrophilic substrates at a target surface pressure of 15 mN/m. A LB film of 15 layers of stearic acid is deposited onto the solid substrate. The hydrophilic (HPL) substrates were prepared by boiling the microscopic glass slides in piranha solution (3:1, conc. H_2SO_4: H_2O_2) for 15 minutes and rinsed successively with Millipore water, absolute alcohol and acetone solvents.

The substrates were then dried by blowing hot air at 70ºC. The glass substrates were immersed in the subphase prior to spreading the solution. The monolayer is gradually compressed using the moveable barrier to reduce the area per molecule. Surface pressure- area per molecule (π-A) isotherm was obtained by compressing the monolayer at the A-W interface in a Langmuir trough (LB2004DC, Apex Instruments).

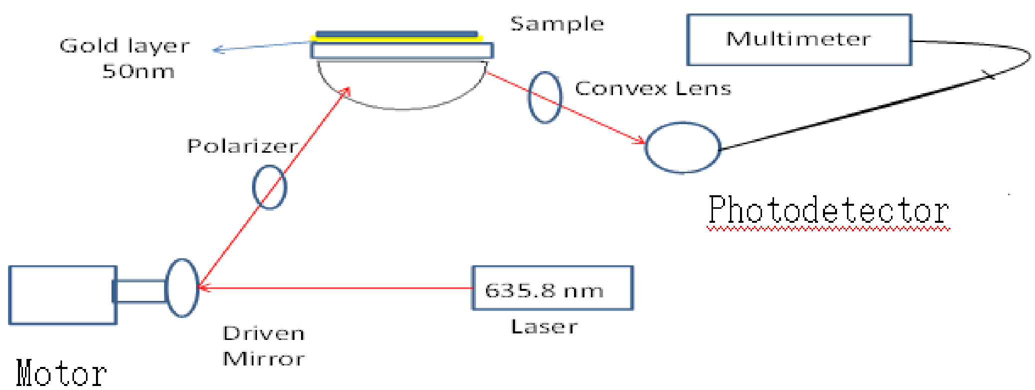

Figure 1: Experimental setup for recording the surface Plasmon resonance angle

RESULTS AND DISCUSSIONS

The surface Plasmon resonance sensograms are recorded for 50 nm gold film, bulk solution of stearic acid in alcohol and 15 layers of LB film of stearic acid deposited on glass plate and are shown in Figure 2.

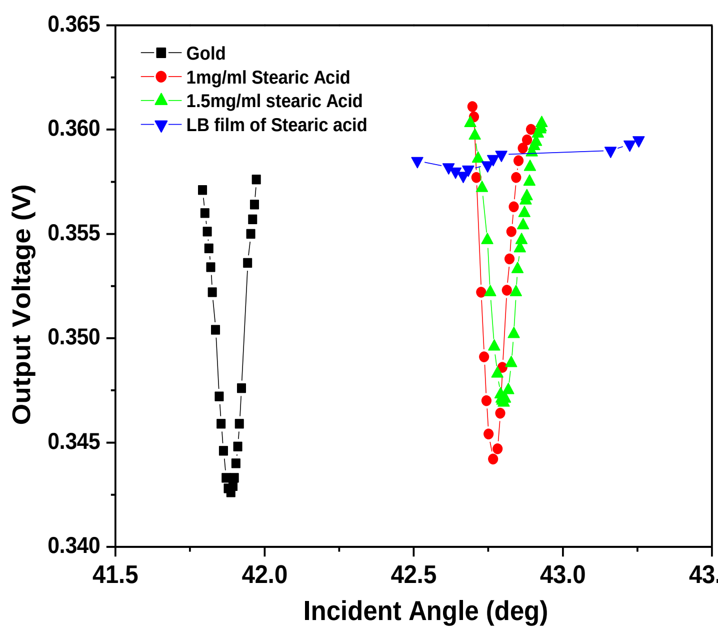

Figure 2: The surface Plasmon resonance sensograms for pure 50 nm gold film, bulk solution of stearic acid on alcohol and 15 layers of LB films of stearic acid deposited onto glass substrate at 15 mN/m.

The surface Plasmon resonance angle for pure gold film was observed at 41.9^o angle of incidence. The resonance angle for alcohol solutions of stearic acids at a concentration of 1 and 1.5 mg/ml were obtained at 42.76^o and 42.8^o, respectively. Similarly the resonance angle for the LB film was obtained at 42.67^o. The resonance angle shifts towards low angle of incidence with the decrease in the concentration of the stearic acid in the alcohol solution. The LB film of 15 layers of stearic acid is intermediate between the 2 dimensional and 3 dimensional systems and the stearic acid concentration is much lower as compared to that of bulk solution. As a result, the resonance angle for LB was found to be lower as compared to that of bulk solution.

CONCLUSION

The developed SPR instrument is capable of detecting small concentration of the molecules adsorbed at an interface. The resolution of the instrument is high as it can able to detect the change in angle of incidence of the order of 3 millidegree.

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