It is very different to deposit thick

[Literature](), [Russian Literature]()

It is preferred to synthesize thethin film structure Au/4-Carboxythiophenol/CdS/substrate in this order ratherthan CdS/4-Carboxythiophenol/Au/substrate. 4-carboxythiophenol layer is self-assembledmonolayer (SAM) which contains bifunctional groups (carboxyl (-COOH) and thiol (-SH). Au is most extensively studied substrate for growing thiol based SAM due to thestrong affinity of sulfur for Au. However, the stability of thiol SAM on Au remainsa matter of debate as thiol chemisorption reaction is kinetically favorable butthermodynamically unstable 1.

There exists a weak adhesion between Au and theinsulating substrate. Researchers have demonstrated the formation of II-VIsemiconductor (CdS and CdSe) nanoparticles on SAM through the selective ionicinteraction and mixed ion-by-ion mechanism 2, 3. These results show only CdS nanostructures, clusters of nanoparticles are possibly grown on SAM not as the continuousuniform film. Due to foreseen above issues, it is not advisable to stack the thinfilm structure CdS/SAM/Au.

The other stack structure (Au/SAM/CdS) doesn't haveany critical issues. CdS film can be deposited on an insulating substratewithout any adhesion problems. For the bifunctional SAM, the molecules willreorient in accordance with the substrates 4.

With CdS substrate, SAM willgrow with carboxyl group heading towards CdS surface and leaving thiol group onthe top. Now, Au can be easily deposited on top of thiol group of SAM. Hence, Au/SAM/CdS will be better stack for this thin film structure. Chemical bathdeposition (CBD) and chemical vapor deposition (CVD) are the two techniquesused to deposit the thin film (5 nm) of CdS layer on insulating substrate. In CBD, the deposition proceeds with two mechanisms (i) ion-by-ion growth on the substrate(i. e growth by successive Cd2+ and S2- adsorption on thegrowing substrate-heterogeneous reaction) and (ii) cluster by cluster growth(clusters of Cd(OH)2 adsorb on the substrate and coagulate to formthe film – homogeneous reaction) 5, 6. The film properties are mainly dependingon deposition mechanism, literatures have cited that ion by ion mechanismyields dense and well adherent film whereas cluster by cluster mechanism yieldsporous and less adherent film.

CBD is an attractive technique which can be employedat low temperatures and suitable for large area processing which makes itinexpensive 2 whereas, the drawback is not all substrates can be used and itis very different to deposit thick layers. CVD is another great technique to depositCdS film. In CVD, the precursor molecule adsorbs on the substrate, thendecomposes on the substrate or reacts to leave a deposit. The reaction used forthe deposition of CdS films (i) The main advantagesof CVD are wide range of film thickness can be achieved, high deposition rate, dopantconcentration and distribution of film are of better control whereas the maindrawback is poor step coverage, volatile precursors at room temperatures. Thebifunctional SAM (4-Carboxythiophenol layer) can be grown on CdS film by simpleself-assembly. Self-assembly of ordered monolayers are grown by immersing the CdSsubstrate into Carboxythiophenol solution for 24 hours at room temperature. Thebifunctional SAM will reorient and carboxyl group gets adsorb on CdS substrateforming linkage between -COOH from SAM and Cd from CdS.

Self -assembly processis relatively simple, it has large variability and multilayers can be grown. The biggest disadvantage is layer stability and contamination. Sputtering andElectron Beam Induced Deposition (EBID) are better techniques to deposit Au onSAM. Sputtering is the physical vapor deposition in which energetic ionsstrikes the target materials, which ejects and deposit on the substrate andthis method is particularly used to deposit thin metallic films. The advantagesof sputtering are better step coverage, better film quality, easier to controldeposition thickness, whereas the limitations are low deposition rate, generatesenormous heat. In EBID process, high energetic electron beam is directed tostrike the target and deposit the film on the substrate. This produces theuniform Au film on the substrate.

EBID offers many advantages such as highdeposition rates, low contamination, dense film, better thermal efficiency butthe limitations are not usable to coat the inner surfaces of complex geometries. 5 nm CdS film are characterized by X-Ray Diffraction (XRD) and Transmission Spectra. XRD is the nondestructive technique in which X-rays are incident to CdS surfaceand X-rays will diffract in specific planes of the CdS crystals. XRD patternsof CdS films prepared at different solution temperatures are shown in Fig 1. The intense peak located at 2? = 26. 6° which refers to(111) plane and the other two small ones at 44.

3 and 52. 3° associated to (220) and (311) planes. Theinterplanar distances are obtained from diffraction pattern and it shows CdSfilm have face centered cubic crystal structure 5. The transmissionspectroscopy can be

employed to analyze the optical properties of CdS film. Theabsorption coefficient ? of CdS film can be obtained using Beer-Lambert’s law. The film optical bandgap (Eg) can also be extracted from variationof absorption coefficient with wavelength.

The bifunctional SAM can becharacterized with Scanning Tunneling Microscopy (STM) and Time of flightSecondary Ion Mass Spectroscopy (TOF SIMS). STM is the powerful technique forimaging the surfaces at the atomic scale. Basically, it works with the conceptof quantum tunneling. In STM, when the conducting tip is brought very close tosample, bias is applied such that electrons can tunnel between tip and sample. The high resolution image form can be obtained from tunneling current.

Fig 3shows the STM images of decanethiol SAM on Au (111). TOF SIMS is the massspectroscopy of ionized particles ejected from the surface when it is bombardedby energetic particles (electrons, neutral species, atoms) 8. Fig 4 shows thenegative SIMS of octadecanethiol on Au. X-Ray Photoelectron Spectroscopy (XPS)and XRD are used to characterize the Au film on SAM. XPS is the surface characterizationtechnique in which X-ray photons emits photoelectron after direct transfer ofenergy from the photon to core level electrons 8. Photoelectrons emitted and separatedaccording to binding energy. Since it is surface sensitive XPS result will haveonly Au peak not the underlying layers.