Monitoring Organic Thin Film Growth *in-situ* with Combined Quartz Crystal Microbalance and Ellipsometry

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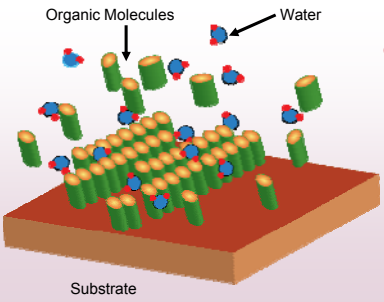
Our message

- **Simultaneous measurement of organic thin fim using Quartz Crystal Microbalance (QCM) and Spectroscopic Ellipsometry (SE).**
- **Synperonic in aqueous phase deposited on octadecane thiol coated gold surface is used as a model system.**
- **QCM is measures total mass including water entrapped in the thin organic film whereas SE excludes water in the measurement. The combination of the two instruments allows one to determine the porosity and thereby find the water content.**

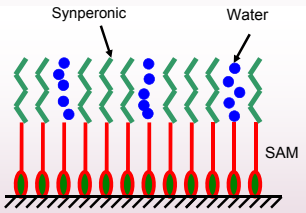
Studying water rich organic thin films



What is the **water content** of organic thin films in an aqueous environment?

Porosity holds the key!

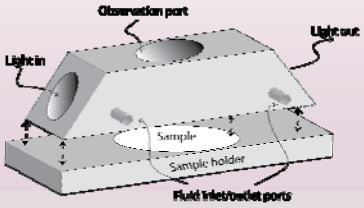
Methods to investigate this phenomena are:
- Optical
- Mechanical
- Combination of optical and
- mechanical methods

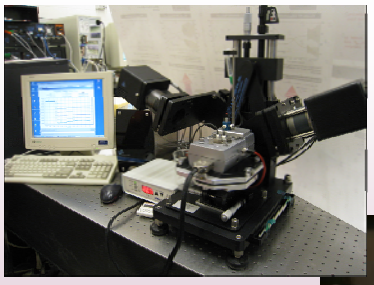


Description of System Studied

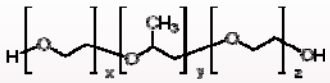
Instrumentation

QCM-SE liquid cell
- Specially designed cell allows for simultaneous measurement of mass uptake by SE and QCM.
- QCM readings taken from sample surface





Model System

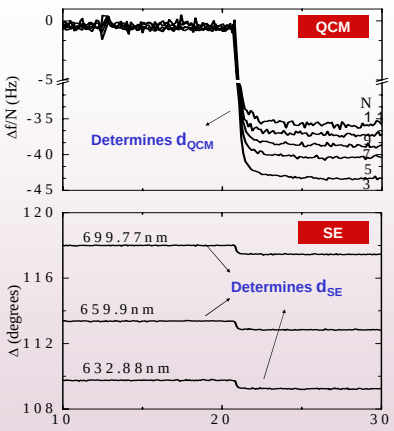


Synperonic PE/F68

- A self-assembled monolayer (SAM) composed of octadecanethiol was first assembled on to the gold surface. This was done to make the surface hydrophobic.
- Synperonic was introduced to form a thin organic film on the SAM.

Measurement of Film Thickness and Determining the Porosity

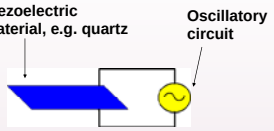
QCM and SE

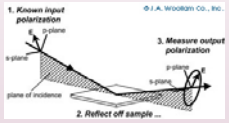


Top panel: Frequency shift normalized by harmonic number as determined by QCM. Note that the graphs do not overlap after polymer introduction. This indicates formation of a viscoelastic film.

Bottom panel: Δ at selected wavelengths from *in-situ* scanning ellipsometry (SE) measurement.

Quartz Crystal Microbalance (QCM)

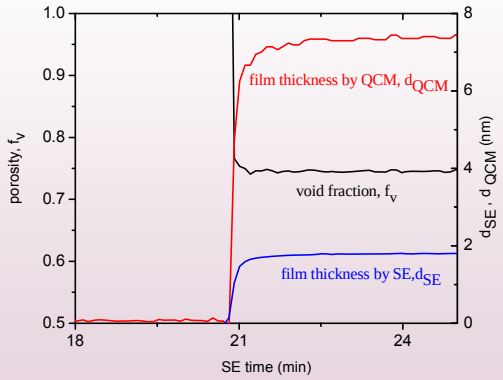




In-situ Spectroscopic Ellipsometry (SE)

Determination of Porosity, f_v

$$f_v = \frac{\rho_o\,(d_{QCM} - d_{SE})}{\rho_{H_2O} d_{SE} + \rho_o\,(d_{QCM} - d_{SE})}$$



The graph above displays the calculated thickness of synperonic film over time as calculated from QCM data (d_{QCM}) and SE data (d_{SE}). Also shown is the variation of porosity (f_v) over time as the film is formed. Knowing the porosity yields an insight to the amount of trapped water in the organic thin film

Materials Research Society Fall Meeting 2008, December 1-5, Boston, MA