

Self-Assembled Monolayers (SAMs)

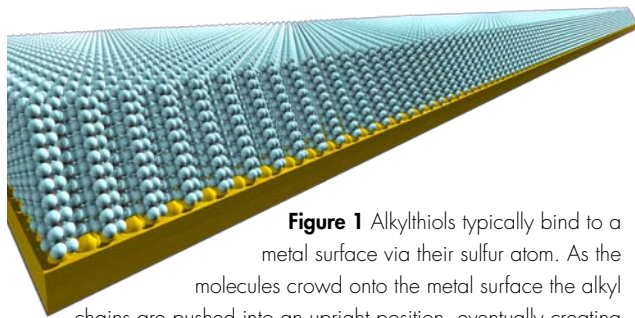


Figure 1 Alkylthiols typically bind to a metal surface via their sulfur atom. As the molecules crowd onto the metal surface the alkyl chains are pushed into an upright position, eventually creating a self-assembled monolayer (SAM).

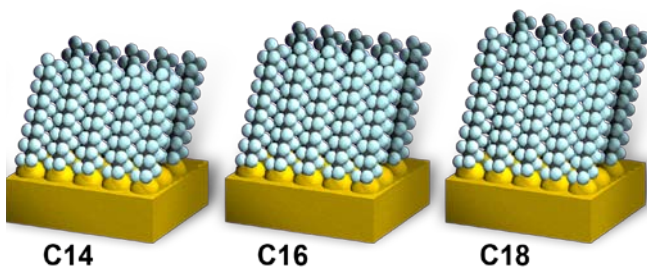


Figure 2 SAMs of varying thickness can be created by using alkylthiols containing different numbers of carbon atoms.

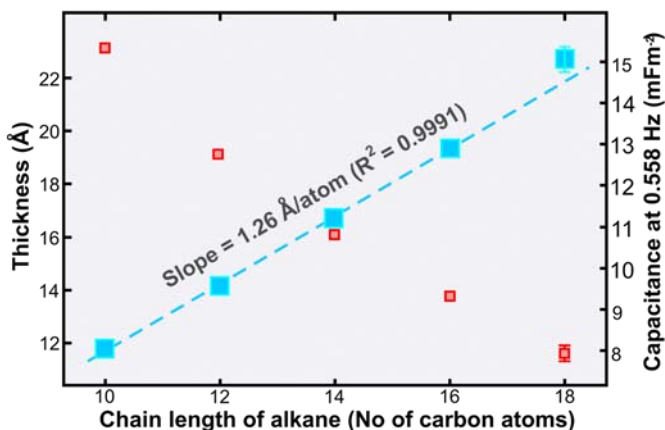


Figure 3 Results of an EIS experiment showing how the capacitance of the SAM varies as chain length (number of carbon atoms). Use of the dielectric constant for a corresponding alkane allows the thickness of the SAM to be determined.

With the INPHAZE HiRes-EIS system you can investigate:

- molecular structure
- location and effects of molecules within the structure
- electrical ion transport properties
- biosensor applications

Self assembled organic monolayers (SAMs) and films can be readily constructed on gold, or other metal, substrates using alkylthiol molecules to form a metal-sulfur bond, Figure 1. The depth of this layer can be adjusted by using different chain lengths, Figures 2 and 3.

SAMs can also be constructed on the surface of silicon wafers, using direct silicon-carbon bonds.

Attachment of simple alkane chains creates a hydrophobic surface to which lipophilic molecules (such as membrane phospholipids) will be attracted, Figure 4.

Functionalized SAMs usually have the other end of the alkyl chain terminating in a $-\text{COOH}$, $-\text{NH}_2$ or similar group. This allows attachment of proteins, or other larger molecules. These additional layers (such as antibodies) can be used as the basis for the construction of biosensors.

Electrically such composite or hybrid films can be subdivided into dielectric layers corresponding to chemical groupings such as the alkyl chains of the SAM, the terminal $-\text{COOH}$ (or $-\text{NH}_2$) moieties. The INPHAZE HiRes-EIS system can identify the dielectric properties of these individual layers, Figures 5 and 6.

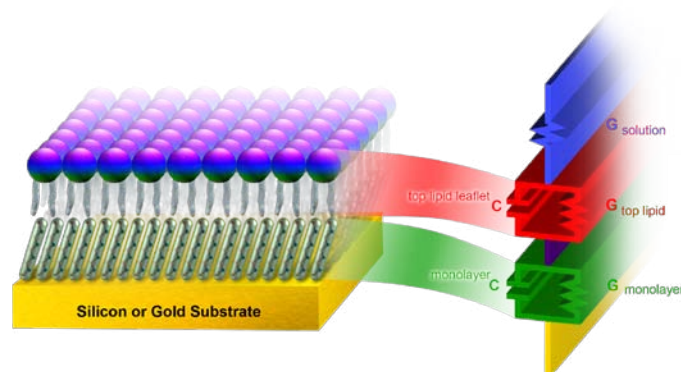


Figure 4 Simple model a hybrid layered structure as a series of pairs of a capacitor (C) and a conductance (G)

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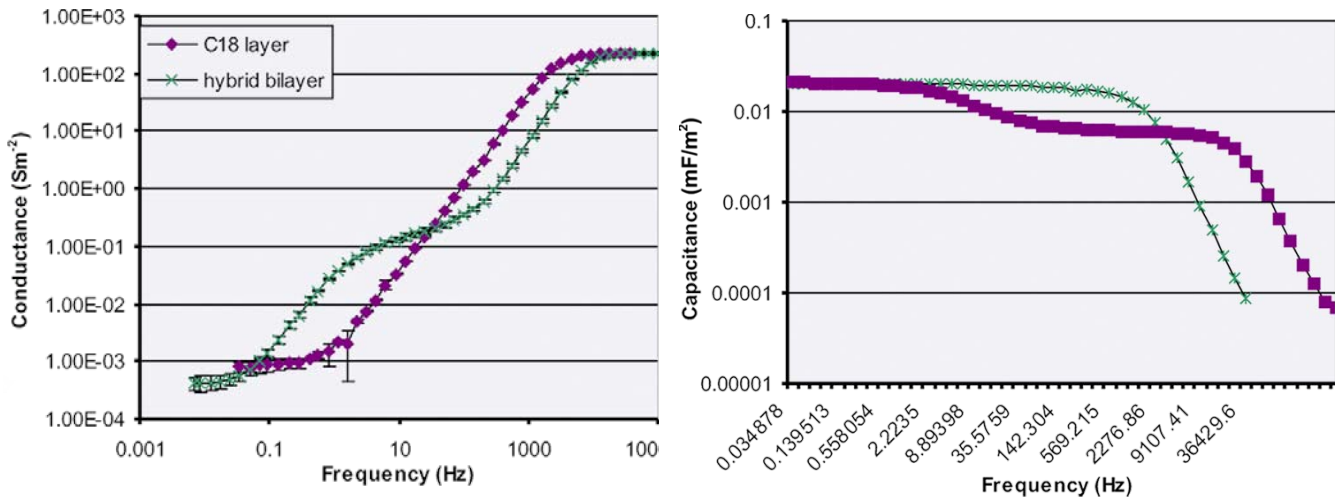


Figure 5 Graph of Conductance (left) and Capacitance (right) as a function of Frequency. A simple C18 alkyl chain monolayer (purple) is compared with a hybrid bilayer (alkyl chain layer supporting lipid layer, green), as shown in Figure 4. The effect of the addition of the lipid layer is clearly seen.

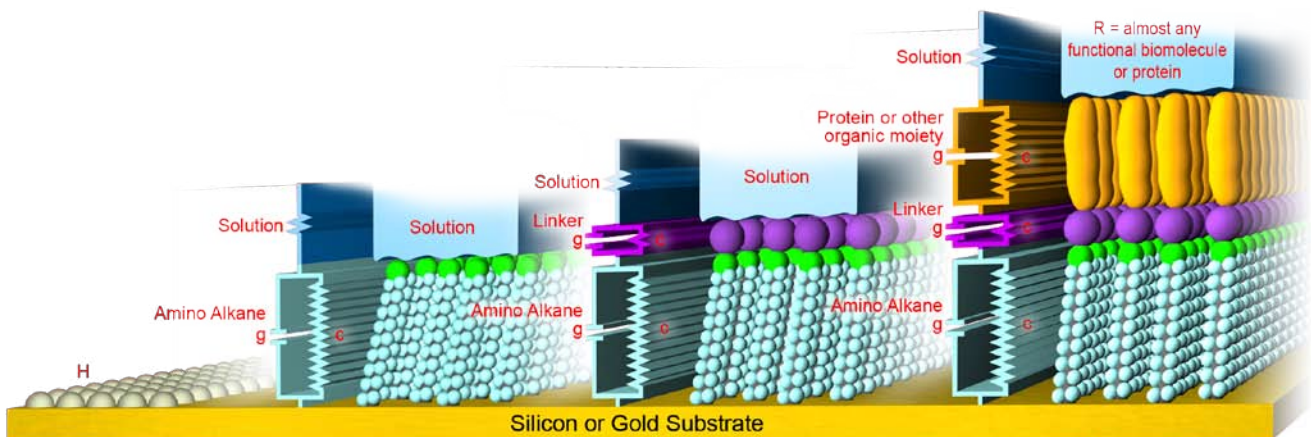


Figure 6 Complex structures can be built by the use of linking molecules that are first attached to a fractionalized SAM and then to an arbitrary sized molecule, often an enzyme or antibody. This requires a model containing more pairs of capacitances and conductances, one pair for each layer.

INPHAZE Key Specifications

Impedance range:	0.1 – 10 ¹⁰ ohm
Phase resolution:	0.001 degrees
Magnitude error:	0.002%
Frequency range:	0.001 – 10 ⁶ Hz
Configurations:	2, 3, or 4-electrode
<i>Specifications may be altered at any time. Please confirm with your vendor.</i>	



WARRANTY: INPHAZE hardware units are supported by a two year warranty

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