INPHAZE High Resolution Characterisation

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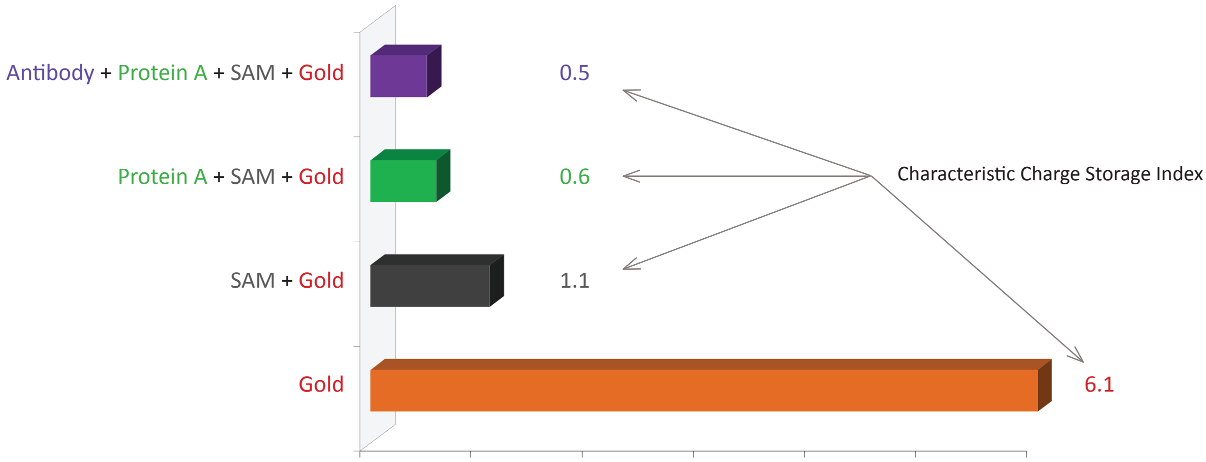
INPHAZE offers a powerful high-resolution system for characterising biological materials and processes at the nano scale. A wide range of precision chambers are available to suit specific applications. Along with user friendly software and dedicated support, talk to us today about using the INPHAZE system for your research.

Bio Applications

Biosensors

In most biosensors one of the reagents is immobilised on a surface, then the sensor is exposed to the target reagent. Here as an example, a biosensor was devised by immobilising Protein A on a SAM formed on a gold surface, then exposed to the antibody to Protein A. The formation of each individual layer was monitored and characterised by the INPHAZE system, which also provided information on the thickness values.



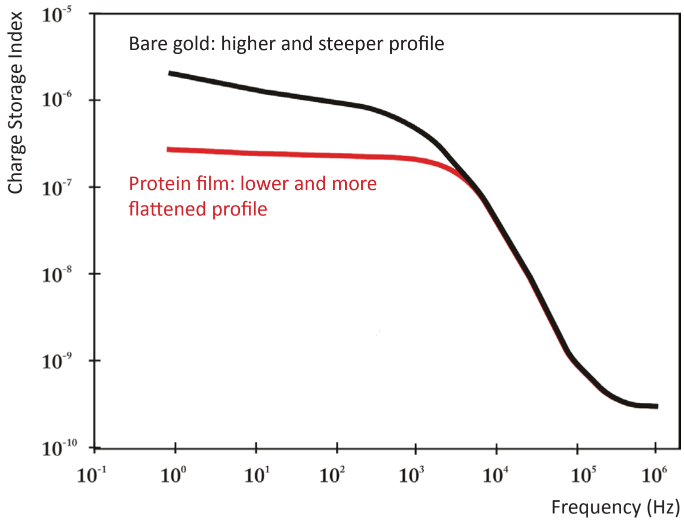
Characterising the individual layers in the biosensor (Gold represents bare gold)

References:

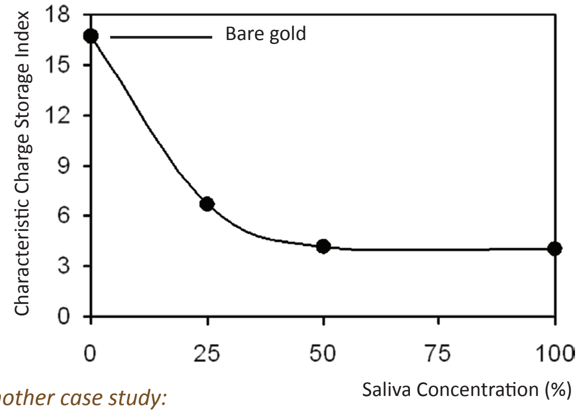
- Mariam Darestani, Hans Coster and Terry Chilcott (2010) "High-resolution AC impedance spectroscopy analysis of the covalently immobilised monolayer of protein-A on SAM for the elaboration of immunosensors", **1st International Nanomedicine Conference**, 30 June - 2 July, Sydney, Australia

Proteins

Most proteins attach to the surface of gold due to the interactions between thiol groups and gold (e.g. through amino acids such as cysteine). The INPHAZE system can detect and characterise this binding process in great detail: (1) The decrease in charge storage index due to the formation of the protein film. (2) The slope of the charge storage index flattens as the formation of the protein film smoothes out the roughness of the gold surface.

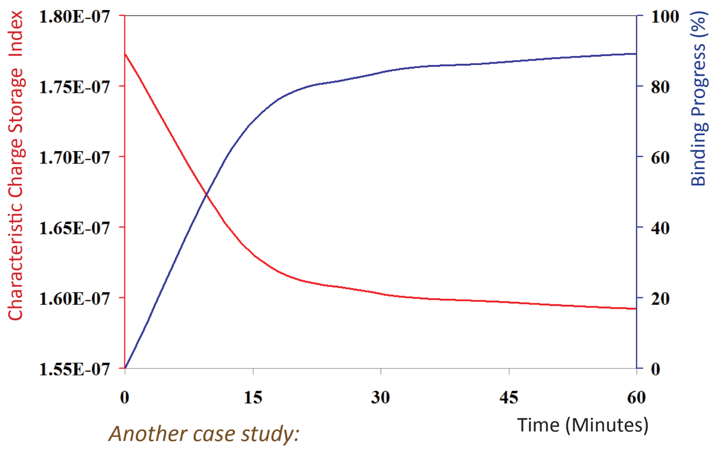


Characterising protein formation on gold surface



Another case study:
Monitoring the binding of saliva glycoprotein to gold

The binding kinetics can also be easily captured with the INPHAZE system.



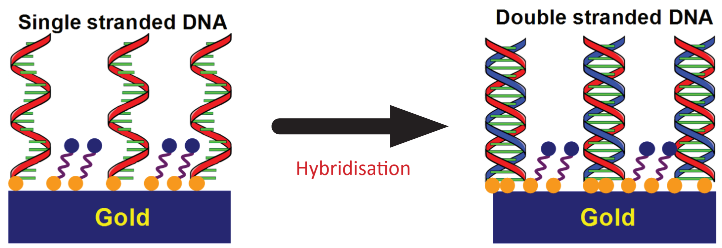
Another case study:
Capturing the binding kinetics of Protein A to gold

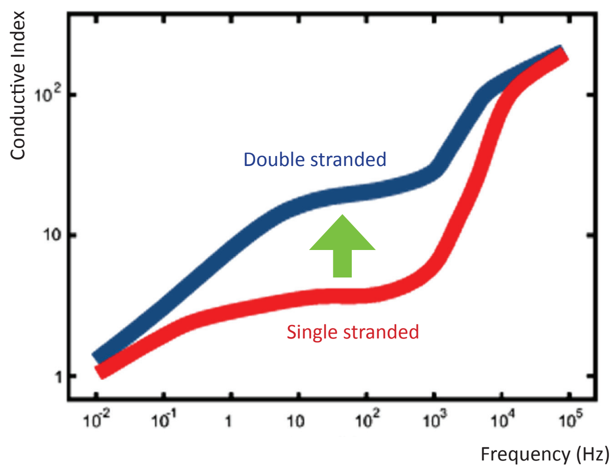
References:

- Kunaal K. Prasad, Hans Coster, Nicolle Packer (2011) "Assaying the Interaction between Streptococcus and Human Salivary Glycoproteins" **The 34th Lorne Conference on Protein Structure and Function**, February 8-12, Lorne, Victoria, Australia

DNA

To detect DNA hybridisation, single stranded DNA can be immobilised on gold, highly doped silicon or any other conductive substrate. When this sensor is exposed to complementary DNA it will form double stranded DNA. With the INPHAZE system, each of these steps can be characterised.





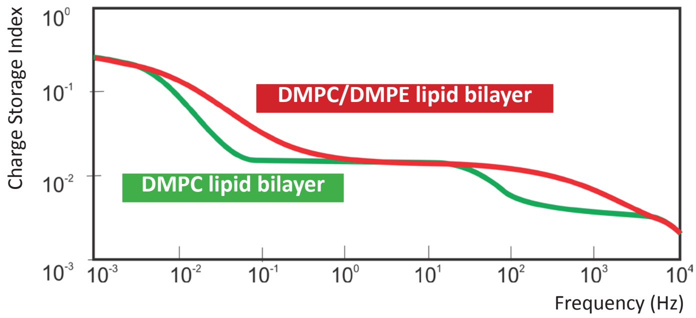
Characterising DNA hybridisation

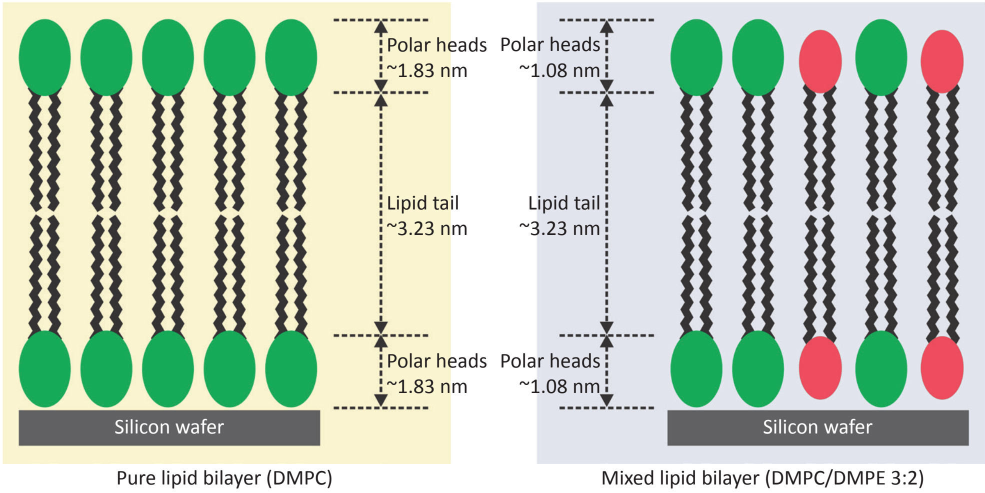
References:

- Terry Chilcott, Elicia Wong, Till Boecking and Hans Coster (2008) "Electrical characterization of biomimetic molecular layers on gold and silicon substrates", **Physiological Measurements**, 29: 307-319

Lipid Membranes

The microstructure and transport behaviour of lipid membranes can be studied with the INPHAZE high resolution system. The INPHAZE technology has been used to characterise free-standing membranes, tethered membranes and supported membranes.





Cell membranes generally contain several types of lipids and the INPHAZE system is particularly useful for determining the structure of mixed lipid membranes.

The results on the left show the detailed dimensions of the various regions that were determined using the INPHAZE high resolution system.

Characterising the dimensions of the various regions in pure DMPC and in DMPC/DMPE mixture

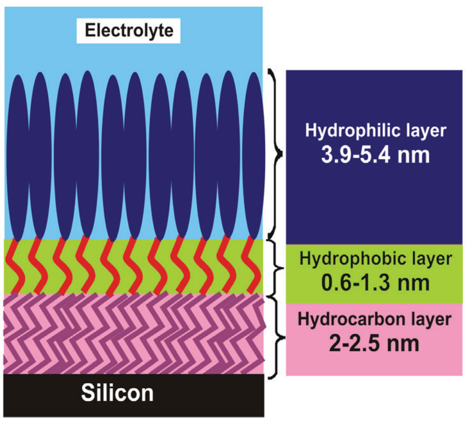
References:

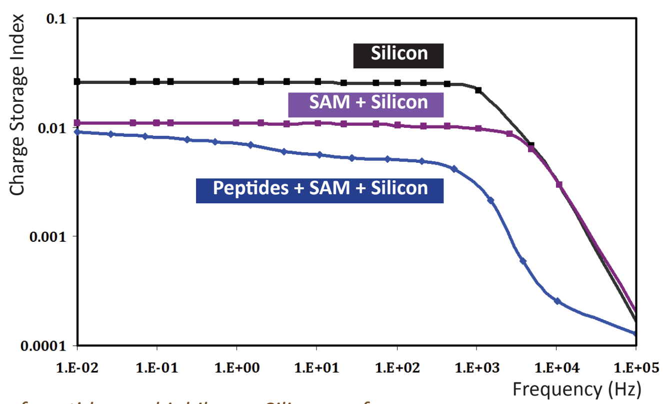
- Masato Nishio, Atsushi Shoji and Masao Sugawara (2012) "Planar Lipid Bilayers Containing Gramicidin A as a Molecular Sensing System Based on an Integrated Current ", **Analytical Science**, 28: 661-667
- Christopher Karolis, Hans Coster, Terry Chilcott, Kevin Barrow (1998) "Differential effects of cholesterol and oxidised-cholesterol in egg lecithin bilayers", **Biochimica et Biophysica Acta** , 1368: 247-255
- Hans Coster, Terry Chilcott and Adele Coster (1996) "Impedance spectroscopy of interfaces, membranes and ultrastructures" **Bioelectrochemistry and Bioenergetics**, 40: 79-98.

Peptides

Synthetic peptides are often employed in the study of biological systems. Peptide amphiphiles can form nano-fibres, which mimic the extra-cellular matrix.

The microstructure of the peptide amphiphiles has been characterised using the INPHAZE high resolution system (results shown below). The thicknesses of the hydrophobic and hydrophilic regions could be obtained with high reproducibility.





Characterising the substructure of peptide amphiphiles on Silicon surface

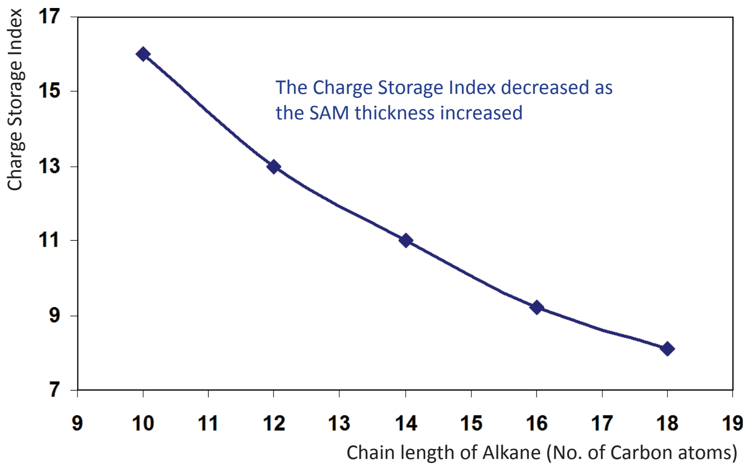
References:

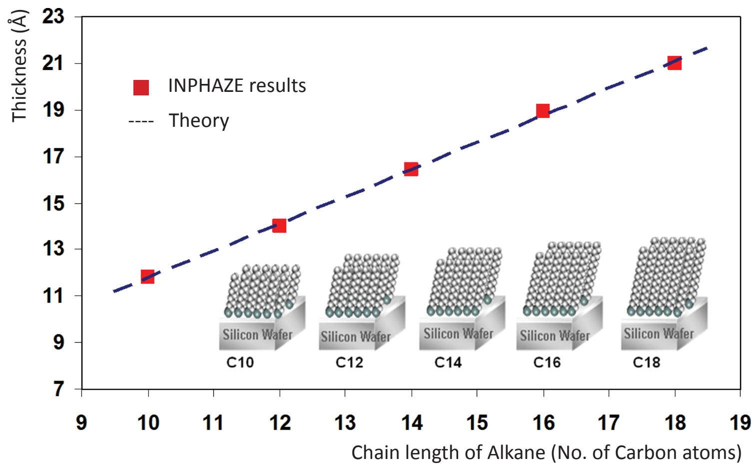
- Fahimeh Shamsi, Hans Coster and Kate Jolliffe (2011) "Characterization of peptide immobilization on an acetylene terminated surface via click chemistry", **Surface science**, 605: 1763-1770
- Fahimeh Shamsi, Hans Coster , Kate Jolliffe and Terry Chilcott (2011) "Characterization of the substructure and properties of immobilized peptides on silicon surface", **Materials Chemistry and Physics**, 126: 955-961

SAM (self assembled monolayer)

SAMs are formed when active chemicals are adsorbed to a surface and form a layer that is one molecule thick. SAMs are well-ordered and easy to functionalise, making them good models for studying sensors, self-organisation and interfacial chemistry.

Two of the most widely used SAMs are gold-alkylthiols and alkylsilanes. The high resolution capability of the INPHAZE system is ideal for characterising SAMs and interfacial layers at the sub-nano scale.





Characterising Alkyl SAM formations on Silicon surface

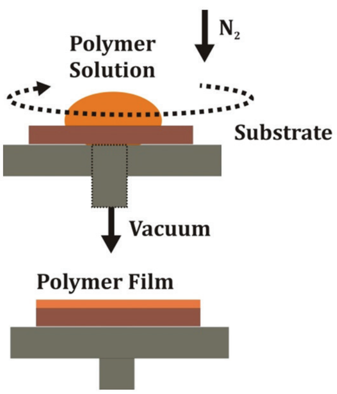
References:

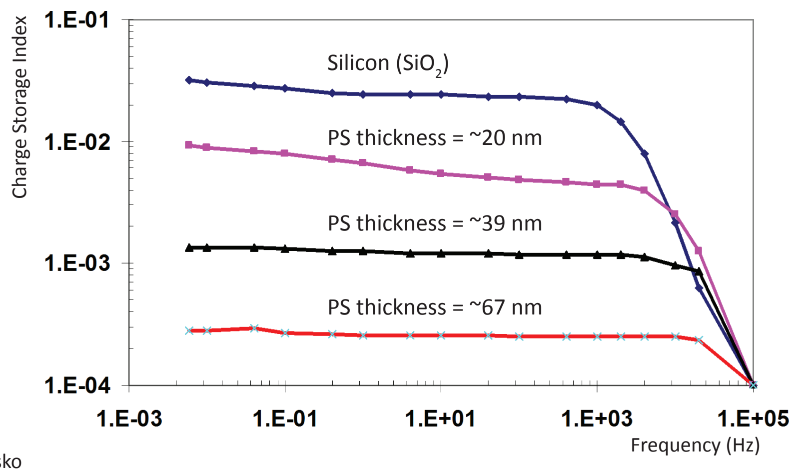
- Hans Coster, Fahimeh Shamsi and Terry Chilcott (2011) "Characterization of the dielectric properties of covalently attached organic films on silicon surfaces", **Thin Solid Films**, 519 6472-6479
- Elicia Wong, Michael James, Terry Chilcott and Hans Coster (2007) "Characterisation of alkyl-functionalised Si (111) using reflectometry and AC impedance spectroscopy", **Surface Science**, 601: 5740-5743
- Elicia Wong, Terry Chilcott, Michael James and Hans Coster (2006) "Electrical impedance spectroscopy characterisations of alkyl-functionalised Silicon (111)", **Biophysical Reviews and Letters**, 1(3): 1-7

Thin polymer films

Characterising and controling thin polymer films are critical in emerging applications such as nano-devices, nano-fluidics, nano-bioreactors and advance separation technologies.

These films are made by spin-coating a dilute solution of the polymer onto a flat surface. The INPHAZE system can be used to measure the thickness of the films and to characterise their internal structure.





Characterising thin polystyrene (PS) films

References:

- Jeffrey Ellis, Hans Coster, Terry Chilcott and David Tomasko (2012) "Structural, compositional and topographical characterisation of polystyrene films using high-resolution impedance spectroscopy", **American Laboratory**, April: 1-3

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