Adsorption and desorption of water on protein-repelling self-assembled monolayers

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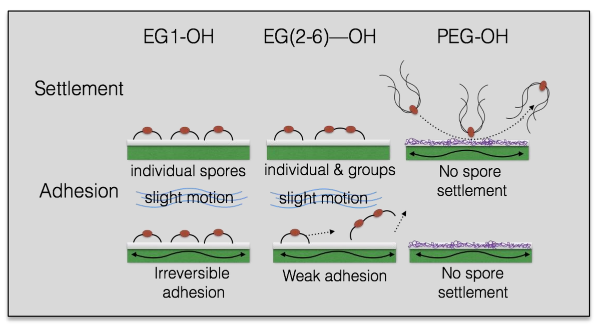
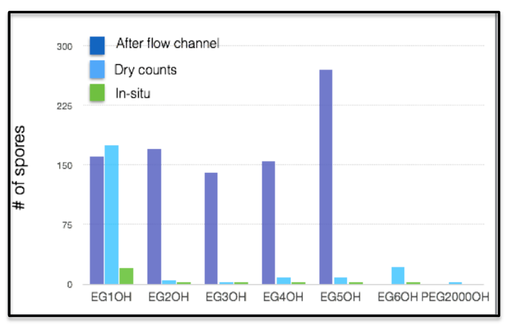
Protein Repelling

- Proteins adhere strongly to almost all materials, which may result in their denaturing.
- There are only few materials which interact weakly with proteins – so called protein-repelling materials.
- The most efficient ones are oligo/poly(ethylene glycols).
- They exhibit protein-repelling properties at sufficient density and amount of material.

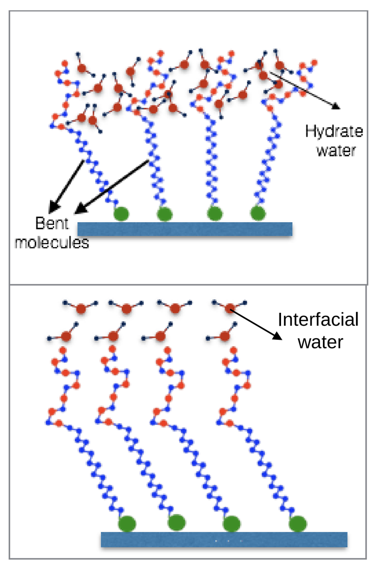




Rosenhahn A. et al, Phys Chem Chem Phys, 2010, 12, 4275

Motivation

To get a better understanding of the mechanism behind the inertness of oligo(ethylene glycol), with respect to biofouling and protein adsorption.

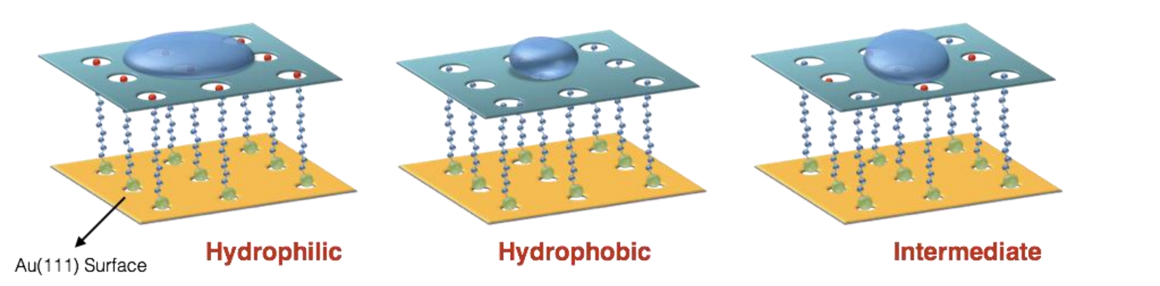


Most theories assume a key role of water adsorption properties related to protein repelling.

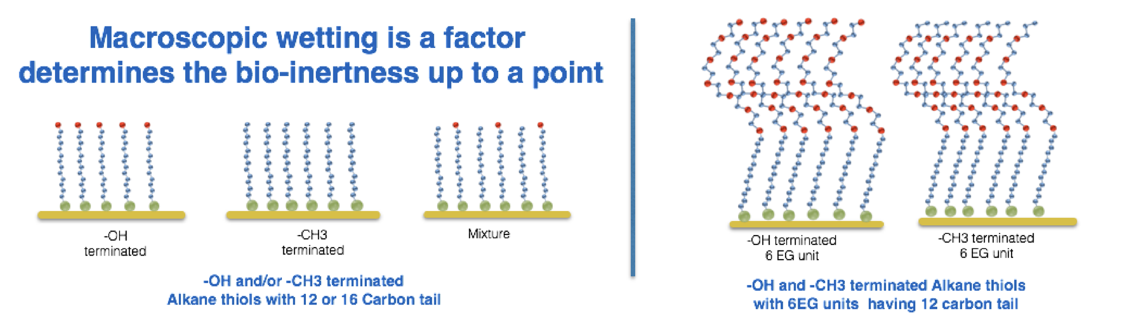
Focus on:

- Kinetics and thermodynamics of water adsorption and desorption.
- Monitoring the transfer from hydration to wetting regime.
- The bonding character of hydration phase.
- The structure and morphology of the interfacial phase.

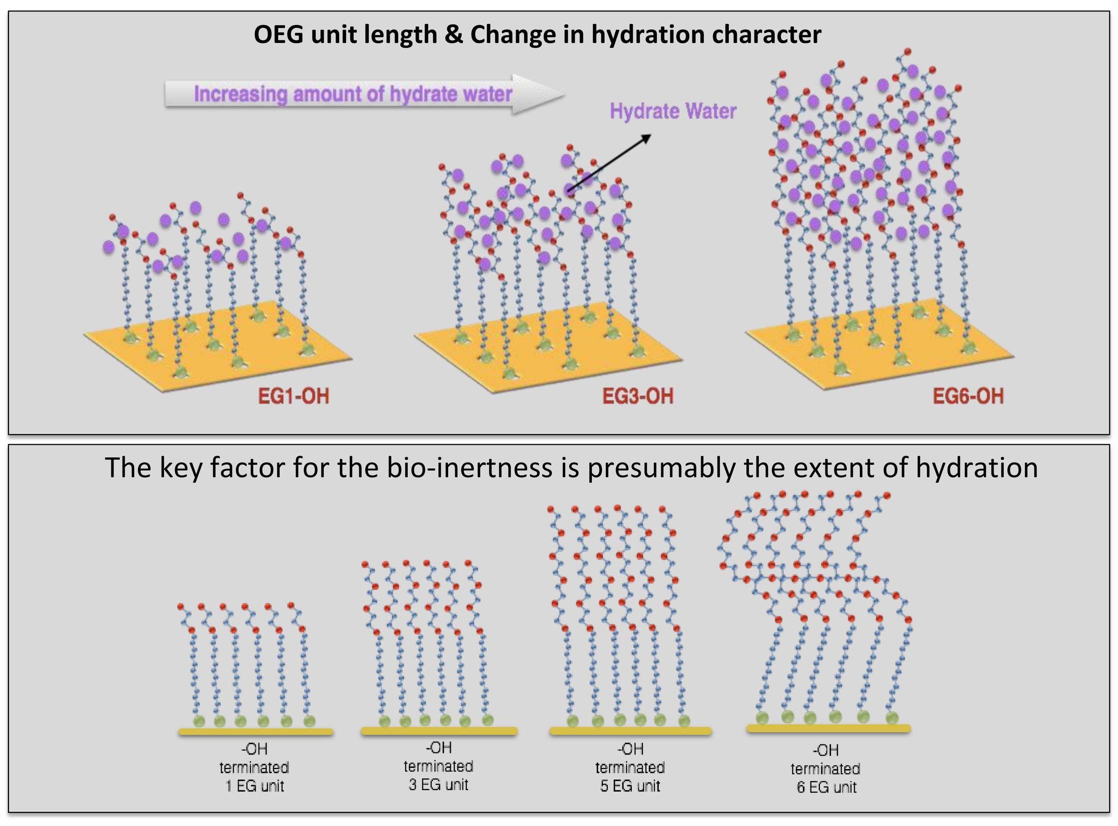
Model System



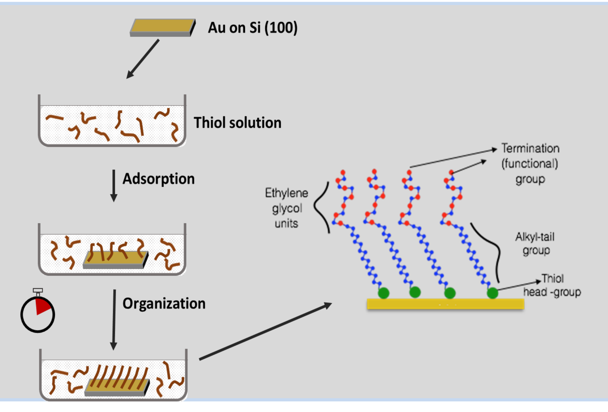
Termination group modification: Changing the macroscopic wetting of the surface



Model System



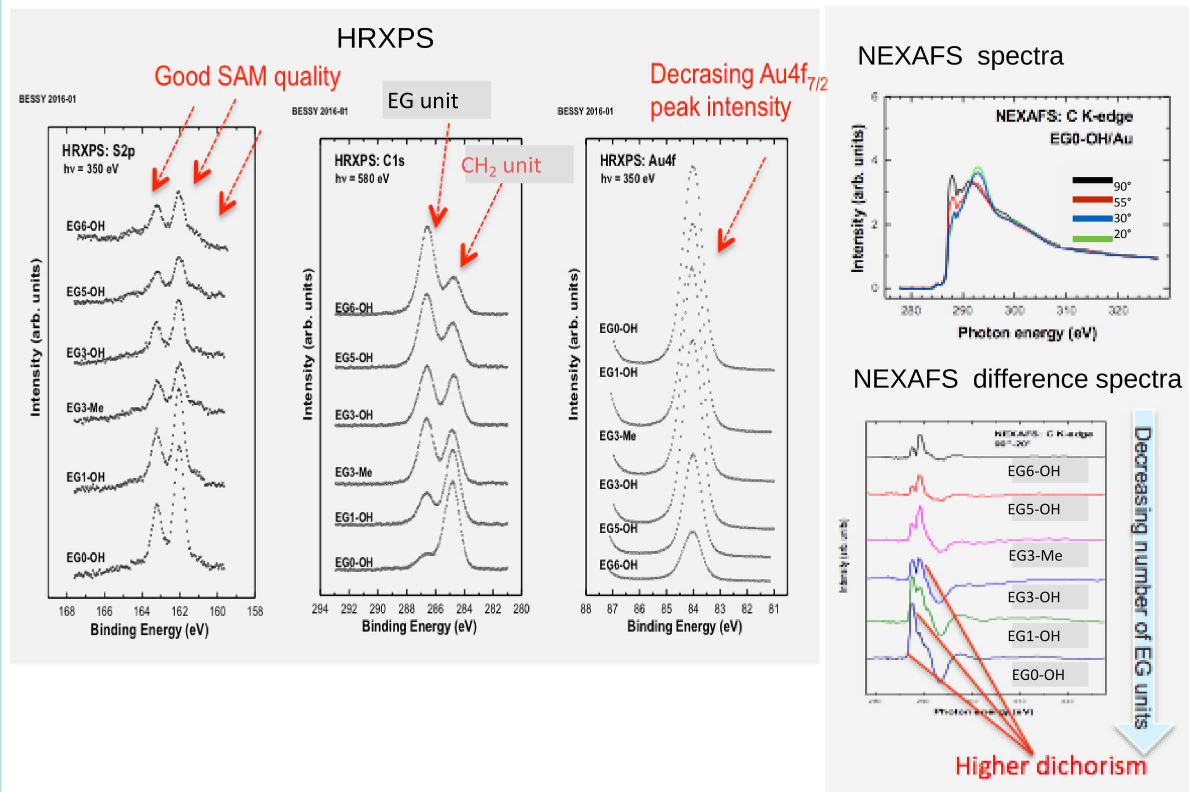
OEG-SAM Preparation and Thin Film Properties



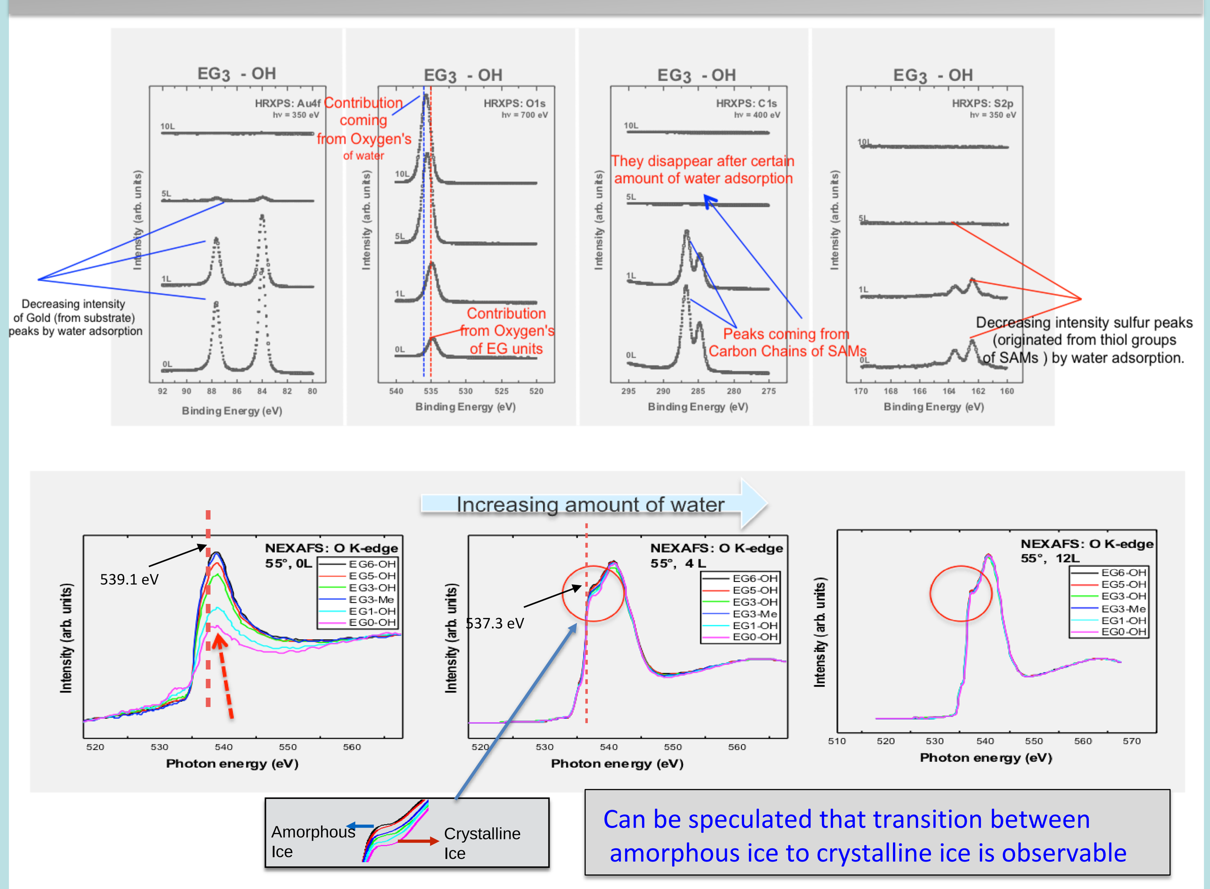
SAMs were prepared on 30nm Au coated silicon wafer substrates by incubation of substrates 24h into 1mM ethanolic solutions of corresponding thiol to form SAMs.

	Packing density	Thickness (Å) XPS	Thickness(Å) Ellipsometry	Contact Angle
C16	21,6	13,2	16	107.6
EG0-OH	21,8	12,6	16	39,9
EG1-OH	24,8	13.2	16,5	44,3
EG3-OH	23,4	16.4	18	32.0
EG5-OH	24,7	19.9	23	34.3
EG6-OH	21,9	24.0	25	34,8
EG3-Me	22,7	16.2	18	42,9
EG6-Me	23,4	24.3	26	43,0

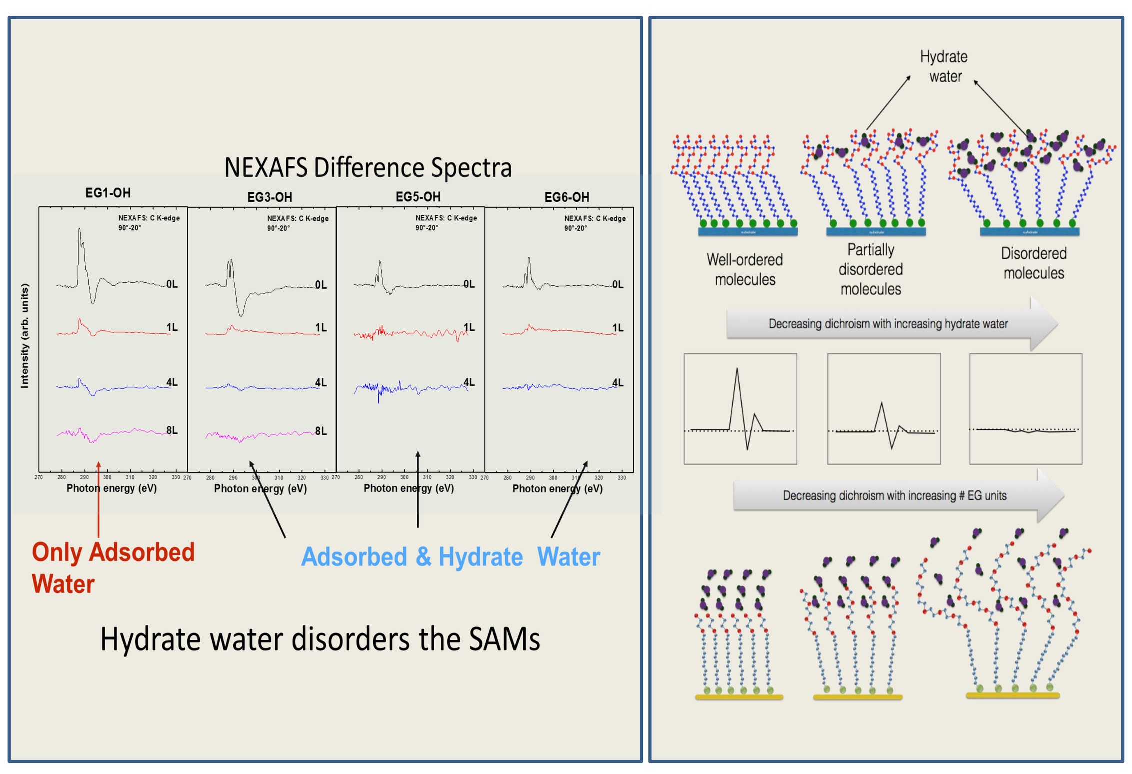
Characterization: HRXPS & NEXAFS



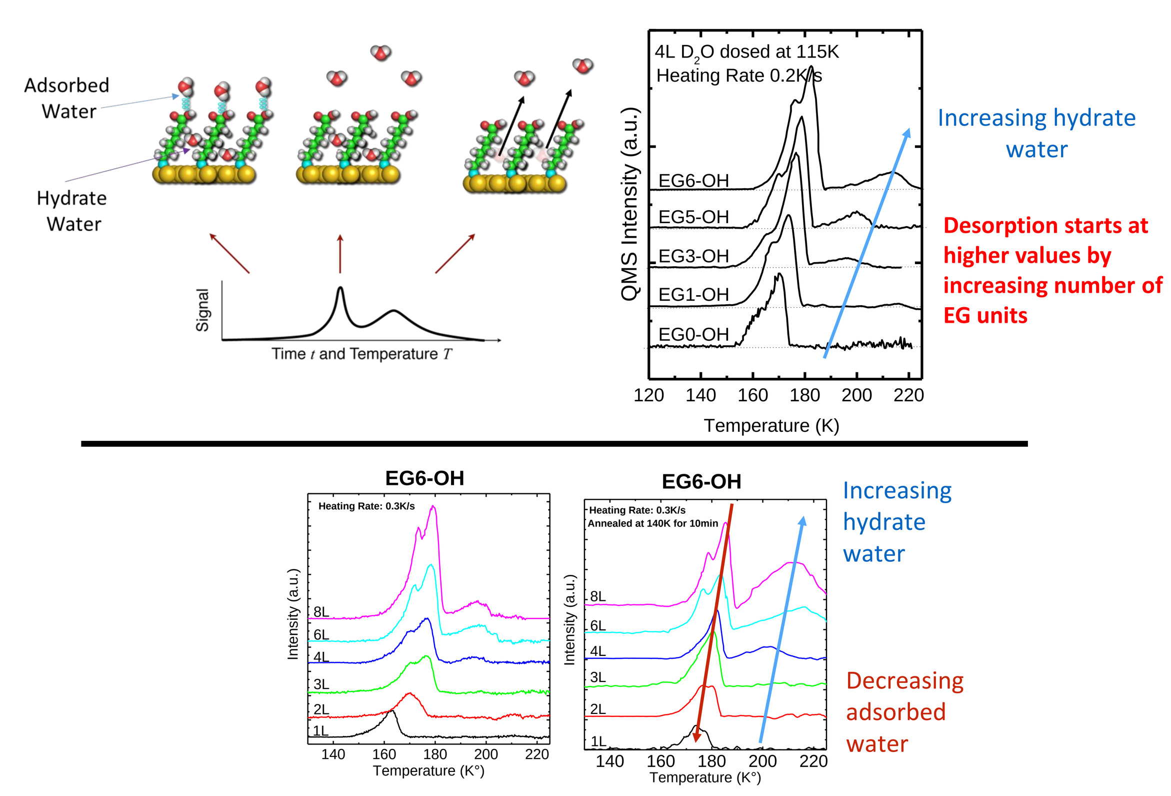
Monitoring of Water Adsorption by HRXPS and NEXAFS



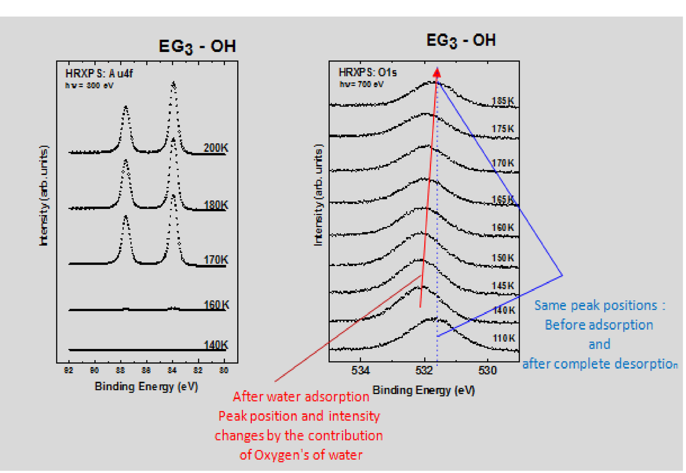
Monitoring of Water Adsorption by NEXAFS

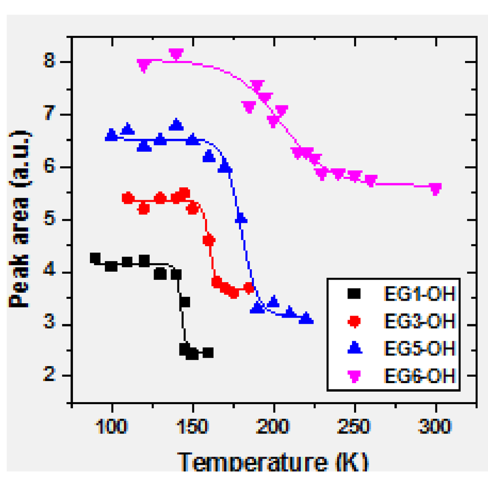


Water Desorption Analysis by TPD

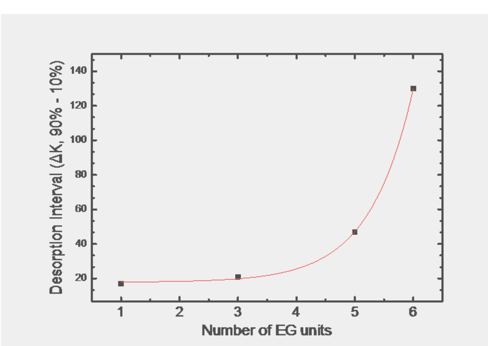


Water Desorption Analysis by HRXPS

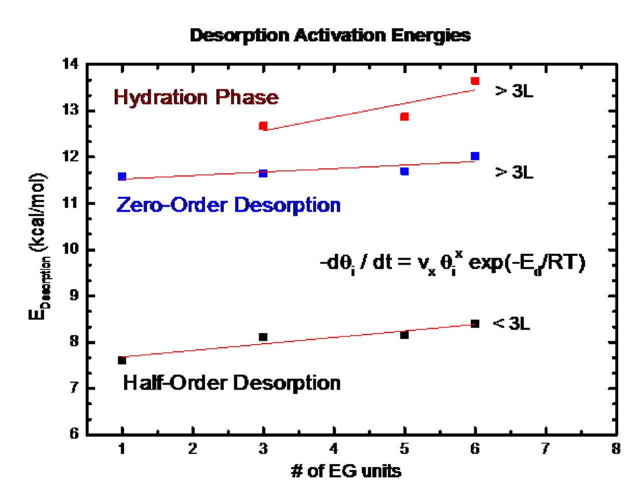


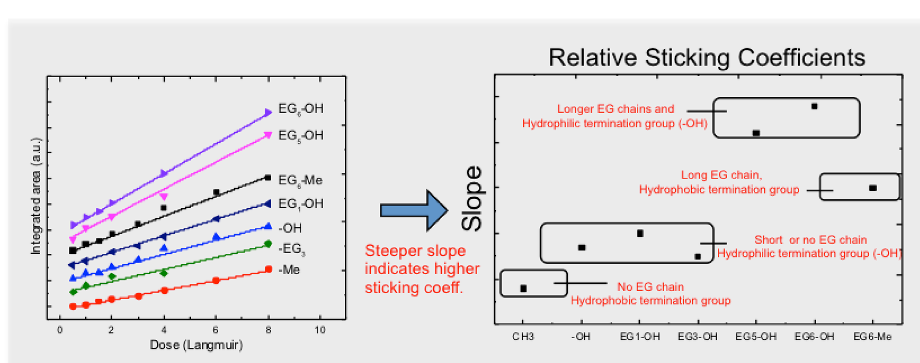


- By increasing amount of EG units desorption temperature moves to higher values.
- Desorption interval gets broader.



Desorption Energy & Sticking Coefficient





Summary

- Series of model OEG-terminated surfaces were prepared.
- Basic characterizations were done.
- The impact of the EG- unit length on hydration was monitored.
- The transition from hydration from wetting regime was observed.
- The kinetics of the water desorption was studied by TPD.
- Desorption energies were calculated

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