

6 Summary

In this thesis, different thiols with various electrochemical active groups have been synthesized. Self-assembled monolayers (SAMs) of these molecules on gold were used to investigate the charge transfer mechanism through organic molecules. In addition, these monolayers were optimized for the directed transport of liquids in a microfluidic device.

Exclusively thiols with ferrocene as electrochemical active group were appropriate for the investigation of the charge transfer mechanism by impedance spectroscopy. By the determination of the charge transfer rates of α -ferrocenylalkane- ω -thiols with different chain length both the validation of the applied measurement method in this thesis and the affirmation of the superexchange tunneling mechanism for aliphatic spacers proposed in literature^{I,II} could be achieved.

During the investigation of ferrocenethiols with chemically different spacers of equal length, a dependence of the charge transfer rate of the molecules on the size of the HOMO-LUMO gap of the spacer was found (Figure I).

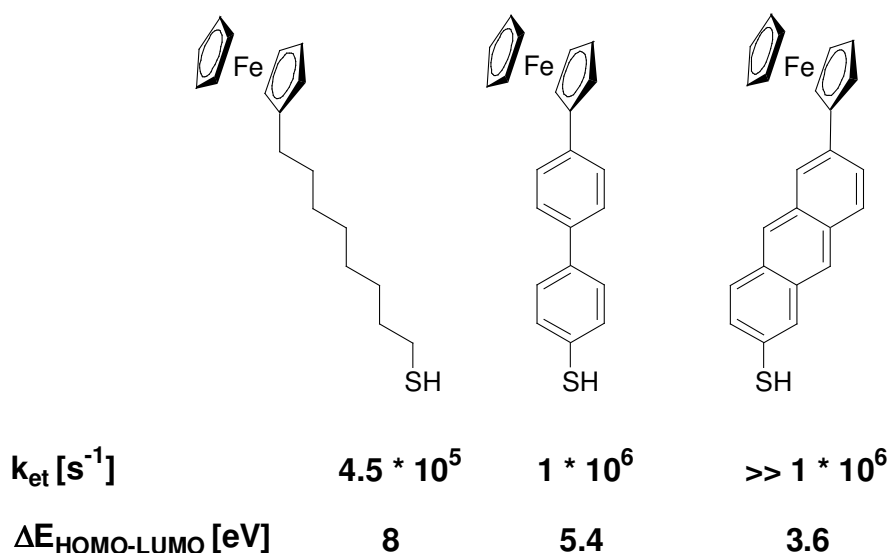


Figure I: Charge transfer rates through ferrocenethiols with equally long, but chemically inequivalent spacers and the size of the HOMO-LUMO gap

In the second part of this thesis, the application of the synthesized ferrocenethiols as SAMs for the fluid transport in a microfluidic device was investigated. The transport

principle was based on the reversible change of the wettability of ferrocene-terminated SAMs through electrochemical reduction or oxidation (Figure II).

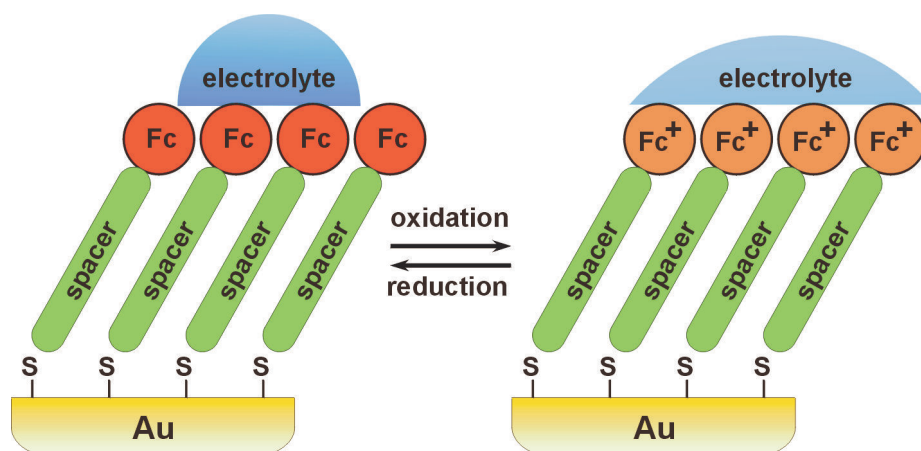


Figure II: Directed, reversible switching of the wettability of SAM covered surfaces by electrochemical oxidation and reduction

A systematic study of the parameter leading to an optimized switching performance of the SAMs was conducted on unstructured gold substrates. The quality of the switching abilities was defined by the magnitude of the change in contact angle upon oxidation/reduction of the ferrocene moiety, the reversibility of this switching process, and the absolute values of the contact angles (CA).

The switching performance of the SAMs is strongly dependent on:

- 1.) the spacer of the ferrocenethiol: aliphatic thiols are better suited than aromatic thiols
- 2.) the applied voltage for oxidation/reduction: ± 200 mV are optimal
- 3.) the mixing ratio between the thiols in the mixed SAM: a fraction of the ferrocene thiol, between 17% and 50%, lead to the best switching performances
- 4.) the roughness of the gold substrate: the contact angle hysteresis was minimal at smooth surfaces

The other investigated parameters (solvent of the thiol solution, incubation time of the substrates in the thiol solution and used electrolyte solution) were found to have less influence on the switching performances of the SAMs.

Through the systematic study of the influence of different parameters on the switching performances of ferrocene thiol SAMs, it was shown that switching

performances of ferrocene-terminated SAMs could be greatly improved in comparison to previously published systems (Figure III).^{III,IV}

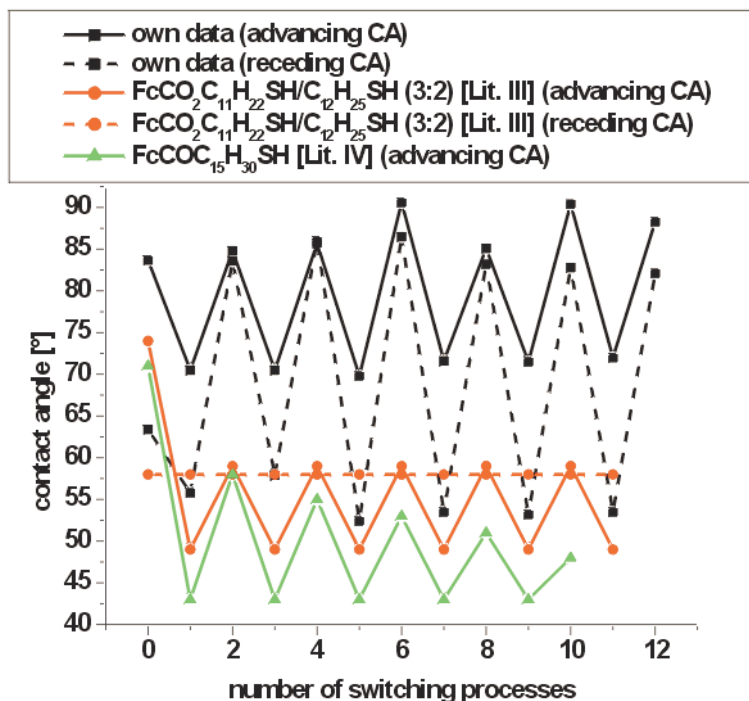


Figure III: Comparison of the switching abilities of a FcC₈H₁₆SH/C₇H₁₅SH (1:1)-SAM measured in this thesis with two literature systems

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