Surface Engineering with SPEM

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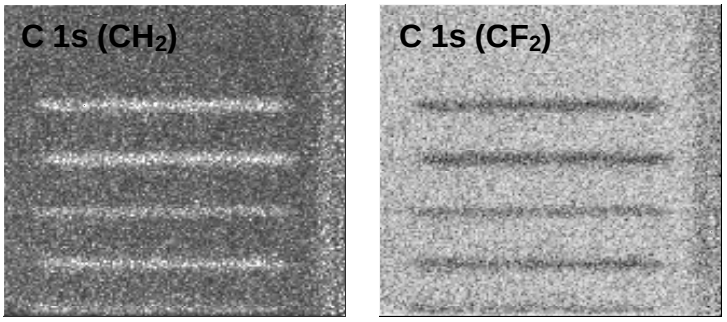
The goal of the project is the development of X-ray lithography with monomolecular resists and zone-plate-focused X-ray beam provided by the scanning photoelectron microscope (SPEM) station [1-3]. As such resists, we used various thiol-derived aliphatic and aromatic self-assembled monolayers (SAMs) on Au and Ag substrates. The fabricated patterns were imaged and characterized by the same SPEM setup used for their fabrication. The major advantage of this approach is its flexibility, so that any pattern can be generated by the exact settings of exposure time per specific area. Further, the patterns can be used as templates for the selective attachment of various substances by in situ exposure to the respective compounds in the gas phase. In parallel, every step of the pattern fabrication and modification can be monitored and analyzed by SPEM.

In this paper, we will present the current status of the project with emphasis on the fabrication of multi-exposure and gradient patterns, and the tailored modification of functional groups. We will address the most important parameters of the patterning process such as selectivity, lateral resolution, and optimal dosage, as well as discuss potential drawbacks of the approach.



C 1s SPEM images of microbeam patterned $CF_3(CF_2)_9(CH_2)_2S$/Ag at the position of hydrocarbon and fluorocarbon emissions. The written lines are 10 micrometer long; they consist of individual points placed 100 nm away from each other. The dwell time per point is 150, 120, 60, 90, and 30 ms, going from the topmost line to the bottom one.

[1] R. Klauser, I.-H. Hong, S.-C. Wang, M. Zharnikov, A. Paul, A. Gölzhäuser, A. Terfort, and T. J. Chuang J. Phys. Chem. B 107 (2003) 13133.
[2] R. Klauser, M.-L. Huang, S.-C. Wang, C.-H. Chen, T. J. Chuang, A. Terfort, and M. Zharnikov Langmuir 20 (2004) 2050.
[3] R. Klauser, C.-H. Chen, M.-L. Huang, S.-C. Wang, T. J. Chuang, and M. Zharnikov, J. Electron Spectroscopy and Rel. Phenom., in press (2005).