HIERARCHICAL SELF-ASSEMBLY: THREE STEPS TO HIGHLY ORDERED ARRAYS OF UNIFORM METAL NANOSTRUCTURES

D. Erb[ab], K. Schlage[a], R. Röhlsberger[a]

[a] Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg, Germany
[b] present address: Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany

Nanopatterning via self-assembly has gained considerable interest as an alternative to lithography-based techniques for nanostructure fabrication. We propose a procedure for producing highly ordered arrays of uniform metallic nanostructures based exclusively on three subsequent self-assembly processes [1]: crystal surface reconstruction, copolymer microphase separation, and metal diffusion on chemically heterogeneous surfaces. The versatile approach allows for preparing nanostructures with scalable sizes and in a variety of shapes and materials. With this high-throughput technique, nanopatterns covering areas of several square centimeters can be fabricated easily.

We present results of in-situ structural and magnetic investigations of Fe nanodot arrays during formation by grazing incidence small angle X-ray scattering [2] and nuclear resonant scattering of synchrotron radiation [3], examining the dependence of the nanodot shape on deposition conditions and observing the evolution of magnetic moment dynamics during nanodot growth [4]. Possible applications of self-assembled nanopatterns could range from high-density magnetic data storage to catalysis or sensing based on surface plasmon resonance.

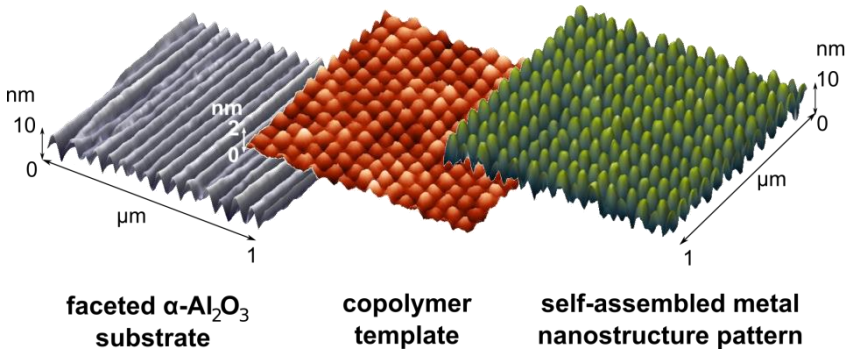

Figure 1: AFM topography micrographs of the three self-assembling systems combined in the presented procedure. In hierarchical self-assembly, the morphological structures formed in one system guide the structure formation in the following one.

Keywords: self-assembly; diblock copolymers; metal nanostructures

References

[1] D. Erb, K. Schlage, R. Röhlsberger, Science Advances 1 (2015) e1500751
[2] G. Renaud, R. Lazzari, and F. Leroy, Surface Science Reports 64 (2009) 255
[3] E. Gerdau and H. de Waard (eds.), Hyperfine Int. 123-124 (1999)
[4] D. Erb, Ph.D. thesis, University of Hamburg (2015)