Exploring amorphous network structures with real space resolution

C. Büchner, S. Stuckenholz, M. Heyde and H.-J. Freund

Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, Germany

Real space information, made available by scanning probe microscopy (SPM) techniques, has greatly improved our understanding of surfaces. The real strength of SPM, however, lies in the structure revelation of complex networks, which cannot be unraveled by conventional spectroscopy techniques. A thin silica film system has been prepared, exhibiting amorphous and ordered regions [1]. Noncontact atomic force microscopy (nc-AFM) and scanning tunneling microscopy (STM) have been employed to reveal a network of varying ring sizes with atomic resolution. The structure can be described in terms of ring size occurrence, arrangements and pair distance histograms, which are directly derived from atomic coordinates.

On the basis of knowing these structural properties, tuning the network structures can be endeavored. Introducing Al as a dopant, combined with subsequent annealing, results in film structures with new characteristics [2]. Ring size distribution and film growth properties in particular are influenced by the element composition. A study of different networks is presented, focusing on the network features studied with SPM.

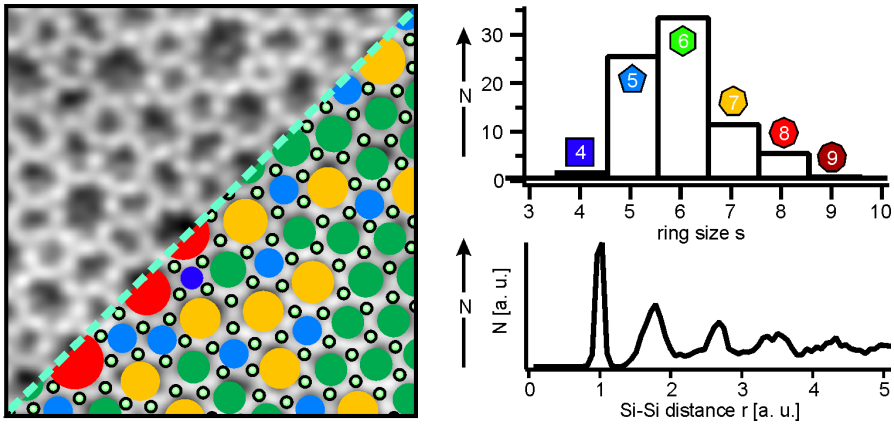

Figure 1: Left: nc-AFM image of an amorphous silica bilayer on Ru(0001). Contrast is sensitive towards oxygen atom sites (4.4×4.4 nm², sample voltage 0.1 V, constant height). The image is partially superimposed with a model of calculated Si sites (small green circles) and different ring sizes (large color coded circles). Right: ring size distribution and Si-Si pair distance histogram, derived from the image on the left, are presented.

References

[1] L. Lichtenstein, **C. Büchner**, B. Yang, S. Shaikhutdinov, M. Heyde, M. Sierka, R. Włodarczyk, J. Sauer and H.-J. Freund, *Angewandte Chemie International Edition* **51** (2012) 404.

[2] J. A. Boscoboinik, X. Yu, B. Yang, F. D. Fischer, R. Włodarczyk, M. Sierka, S. Shaikhutdinov, J. Sauer and H.-J. Freund, *Angewandte Chemie International Edition* **51** (2012) 6005.