

Compositional mapping of semiconductor quantum dots by x-ray photoemission electron microscopy

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In the first part of my talk I will describe the power of x-ray photoelectron spectroscopy (XPS) for chemical analysis of surfaces. In several examples of current interest in nanotechnology I will then motivate the need for laterally resolved XPS and describe one instrument, the x-ray photoemission electron microscope (XPEEM), which is well suited for this purpose [1]. I will also briefly discuss time-resolved studies and the use of x-ray magnetic circular dichroism (XMCD) in combination with XPEEM.

In the second half of my seminar I will focus on the use of XPEEM for compositional mapping of semiconductor quantum dots. Dots were either obtained by *spontaneous* self-assembly during growth of Ge on Si (see Fig. 1) [2], or by *directed* self-assembly during growth of Ge on Au-patterned Si [3]. A detailed XPEEM analysis clearly highlights the differences between these two model systems.

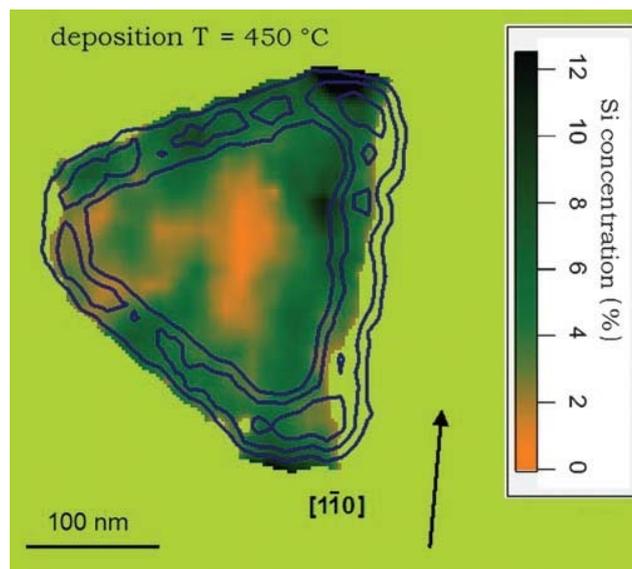


Figure 1: Silicon surface concentration map (~ 30 nm lateral resolution) from a typical Ge(Si) nanostructure grown at 450°C . The contour plot superimposed on the concentration image represents the island geometry as obtained from low energy electron microscopy and shows the island-faceted topography and edge orientation along the $\langle 1-10 \rangle$ directions (~ 10 nm lateral resolution).

References:

- [1] S. Heun: *Nanoscale imaging and spectroscopy with XPEEM*, Journal of the Surface Science Society of Japan **26** (2005) 721 [doi:10.1380/jssj.26.721].
- [2] F. Ratto, A. Locatelli, S. Fontana, S. Kharrazi, S. Ashtaputre, S. K. Kulkarni, S. Heun, and F. Rosei: *Chemical mapping of individual semiconductor nanostructures*, Small **2** (2006) 401.
- [3] J. T. Robinson, F. Ratto, O. Moutanabbir, S. Heun, A. Locatelli, T. O. Montes, L. Aballe, and O. Dubon: *Gold-catalyzed oxide nanopatterns for the directed assembly of Ge island arrays on Si*, Nano Letters **7** (2007) 2655.