Photoelectron spectroscopy on semiconductor nanostructures

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In the last decade, semiconductor systems with reduced dimensionality have attracted great interest regarding their basic physical properties as well as possible electronic and optoelectronic device applications. Lithography and self-organization are commonly used to achieve structure sizes of 100 nm or less. Examples for such nanostructures include quantum dots and quantum wires.

The power of photoelectron spectroscopy for the chemical analysis of sample surfaces is well known. In a traditional experimental setup, the sample is homogeneously illuminated by a x-ray spot with a typical diameter of 1 mm. Therefore traditional photoelectron spectroscopy yields averaged information (typically over a 1 mm^2 sample area). However, on samples with a structure size smaller than this it is highly desirable to perform photoelectron spectroscopy with a sub-µm spatial resolution. This kind of nano-scale photoelectron spectroscopy is very demanding; in particular it requires a very bright light source. The high brilliance and intensity of the x-rays produced by third generation storage rings has therefore led to a strong increase of nano-scale spectroscopy activities over the last decade.

In my seminar I will first briefly review the different approaches to obtain photoelectron spectra from a sub-µm sample area. I will then show some applications of this technique to semiconductor nanostructures, with a particular emphasis on the properties of InAs nanocrystals deposited on Se-terminated GaAs(001) surfaces.