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S E M I N A R

aus

Halbleiterphysik und Nanotechnologie

Di, 29.10.2013, 11:15 Uhr
Hörsaal für Physik

„ SNOM + SERS = TERS
and how functionalized tips can improve this equation

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The talk gives a short introduction to the unique method of the determination of the presence of the material of interest with nanometer resolution – so-called tip-enhanced Raman scattering (TERS). Combining the resolution of scanning near-field optical microscopy (SNOM) and the sensitivity of surface enhanced Raman scattering (SERS), it allows to obtain the information about the investigated system which no other method can provide. Background of the optical sub-diffraction resolution of SNOM as well as of the enhancement allowing to detect specimen by Raman fingerprint to the molecular level is highlighted.

As the tip – surface separation is very small, conditions at the surface and at the tip apex are practically the same what allows to detect Raman signal from substances adsorbed as on the surface as on the tip. Such a duality allows us to implement the concept of the Raman probe for near-field microscopy. This probe is a tip functionalized by the deposition of a necessary reference material and used in the standard SNOM experiment. As the Raman spectrum of any material is very sensitive to all kind of interactions of this material with the environment, changes of the conditions at different measurement points reflects in a change

of the Raman spectrum of this material. Examples of preliminary measurements as well as possible perspectives are presented [1].

As the immediate application of functionalized tips, the use of them as the internal standard in TERS experiments is demonstrated [2]. TERS suffers from the absence of the information about the local enhancement at measurement points what does not allow to obtain the amount of the material generating registered Raman signal. The constant amount of the reference material at each point would generate the reference signal revealing the local enhancement factor and allowing to normalize registered map of the Raman signal of the substance of interest. If the direct implementation of this idea at least contaminates the system, the use of functionalized tips opens the elegant way to resolve this problem. Examples of this approach are presented [2].

In collaboration with U. Fischer (Uni Münster, Germany), T. Schmid, and R. Zenobi (ETH Zürich, Switzerland).

[1] E. G. Bortchagovsky and U. C. Fischer, Nanoscale **4**, 885 (2012).
[2] E. Bortchagovsky, T. Schmid and R. Zenobi, Appl. Phys. Lett., **103** (2013) 043111-1-3.