MM 26: Nanostructured Materials I

Time: Wednesday 10:15–11:15 Location: IFW B

MM 26.1 Wed 10:15 IFW B

Photoexcitation of Volume Plasmons in Metallic Nanostructures — •Katja Ehrhold[1], Ulrich Gösele[1], and Silke Christiansen[2,1] — [1]Max-Planck-Institut, Weinberg 2, 06120 Halle — [2]Institut für Photonische Technologien, Albert-Einstein-Str. 9, 07745 Jena

It has long been known that a vanishing permittivity enables longitudinal electromagnetic waves. The corresponding collective eigenmodes called volume plasmons should not be dipole excitable in classical electrodynamics. Thus, the typical volume modes are known to be excitable via particle beams solely.

We investigated typical scattering problems for an incident plane wave determined via the Helmholtz-equation which can be solved analytically for special geometries. The analytical solution for a spherical scatterer by Gustav Mie was extended to spherical core-shell structures by Aden. Remarkably, in the case of metallic nanoshell structures the Mie extinction efficiencies have a local maximum at the natural plasma frequency corresponding to the photoexcitation of a volume plasmon. This volume mode is independent of both the shell's aspect ratio and the core material. For explanation we present a simple physical picture which is supported by analytical examples on silver and gold shells. Additionally we use finite element simulations to show a potpourri of particles which likewise enable the photoexcitation of volume modes.

MM 26.2 Wed 10:30 IFW B

Formation of dendritic metallic nanowires — •Nitesh Ranjan[1], Hartmut Vinzelberg[2], and Michael Mertig[1] — [1]Institute for Materials Science and Max Bergmann Center of Biomaterials, Dresden University of Technology, D-01062 Dresden, Germany — [2]IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Recently, we reported an electrical-field-controlled growth process for the directed bottom-up assembly of one-dimensional palladium nanowires between micro-fabricated electrodes [1]. The wires, grown from an aqueous palladium salt solution by dielectrophoresis, had a thickness of only 5-10 nm and a length of up to several micrometers. The growth process was found to depend largely on the deposition conditions like the strength and the frequency of the applied AC field and the concentration of the metal salt solution. Here, we report the formation of thin, but straight and dendritic metallic nanowires, obtained in the low-frequency regime. The morphology of the wires was characterized by scanning force microscopy (SFM), scanning electron microscopy and transmission electron microscopy. SFM investigations revealed that the palladium nanowires grown over the glass and silicon substrates have a typical thickness of about 25 nm. Room temperature I-V measurements show them to be Ohmic in nature with a resistance of about 80 kOhm. Low-temperature measurements show the phenomenon of zero bias anomaly. The investigated growth method is capable of controllable in-place formation of complex circuit patterns for future nanoelectronics. [1] Nitesh Ranjan, Hartmut Vinzelberg, Michael Mertig, Small 2, 1490 (2006).

MM 26.3 Wed 10:45 IFW B

A structure-induced metal-insulator transition in thin MoS nanowires — Igor Popov[1], Gotthard Seifert[1], and •Sibylle Gemming[2] — [1]Theoretische Chemie, TU Dresden, D-01062 Dresden, Germany — [2]Forschungszentrum Dresden-Rossendorf, P.O.Box 510119, D-01314 Dresden, Germany

Transition metal chalcohalides MX2 can form a wealth of diverse nanostructures, which range from large octahedral and fullerene-like hollow clusters and cylindrical nanotubes close to the nominal composition M:X = 1:2 to smaller, two-dimensional platelet-shaped clusters under sulfur excess and to one-dimensionally elongated nanowires under sulfur-deficient conditions. All of those structures exhibit specific electronic properties that differ from the ones of the pure bulk and open up a large application spectrum, that includes the lubricant aspect, but extends to catalysis and electronic transport. One-dimensionally delocalized electronic states provide the basis for the higher activity, reactivity and conductivity in such nanostructures. One-dimensional MX wires are composed of a central metallic wire coated by a sulfur and/or halide shell. They exhibit a very high structural regularity, hence, ballistic conductivity may be obtained in such structures. DFT calculations showed that wires can act as electromechanical switches, because they undergo a symmetry-dependent metal-insulator transition upon twisting [Nano Lett.,10.1021/nl801456f; Nano Lett., 2008, 8, 3928-3931].

MM 26.4 Wed 11:00 IFW B

Conductivity and shot noise in graphene at high bias voltages — •Aurelien Fay[1], Romain Danneau[1,2], Fan Wu[1], Matti Tomi[1], Julien Wengler[1], and Pertti Hakonen[1] — [1]Low Temperature Laboratory, Helsinki University of Technology, Espoo, Finland — [2]Institut für Nanotechnology, Forschungszentrum Karlsruhe, and Physikalische Institut, Universität Karlsruhe, Karlsruhe, Germany

The conductivity and the shot-noise in graphene contain both interesting informations on the transport properties of the Dirac fermions. By measuring these two quantities, we have shown that the transport in Graphene could be ballistic [1]. The interaction between optical phonons and charge carriers in graphene can suppress this ballistic transport and, therefore, dramatically changes the conductivity and the Fano factor.

We have increased the electron-phonon coupling in graphene by subjecting the graphene sample at high bias voltages [2]. At a relative low bias, we have measured a linear dependence of the conductivity as a function of the bias voltage. This has been recently pointed out by E. Sonin [3]. In the high bias regime, the decrease of the conductance and the drop of the Fano factor could both be explained by the interaction between optical phonons and charge carriers.

[1] R. Danneau *et al.*, Phys. Rev. Lett. **100**, 196802 (2008).
[2] W.K. Tse *et al*, Appl. Phys. Lett. **93**, 023128 (2008)
[3] E. B. Sonin, Phys. Rev. B **77**, 233408 (2008).