MM 29 Poster Session (SYNW)

Time: Thursday 10:00–11:00 Room: P4

MM 29.1 Thu 10:00 P4

Contacting low dimensional metallic nanostructures on silicon — •Jan Rönspies[1], Svend Vagt[1], Tammo Block[1], Volkmar Zielasek[2], and Herbert Pfnür[1] — [1]Institut für Festkörperphysik, Abteilung Oberflächen, Universität Hannover, Appelstr.2, 30167 Hannover, Germany — [2]Institut für Angewandte und Physikalische Chemie, Universität Bremen, 28359 Bremen, Germnay

The reliable fabrication of electrical contacts to conducting nanostructures is still a challenging problem to be solved. In our experiment we produced nanowires by a lithographic process with electron-beam stimulated thermal desorption of oxygen (EBSTD) in UHV from an ultrathin SiO_2 layer deposited on $Si(557)$ and $Si(111)$ substrates. We formed nanowires with a diameter of $10nm$ and a length of several hundred nanometers with Pb/Si(557) and Ag/Si(111) as example of 1D and 2D systems. For electrical contacting these nanostructures, an ex-situ electron beam lithographic process was used to create $TiSi_2$ macro-contacts forming a gap of a few hundred nanometers. The contacts were evaporated as a multi-layer system of Si followed by a Ti-layer and a capping of Si on a $Si(557)$ substrate to avoid stress induced trenches at the transition between the contacts and the substrate. We studied these contacts by SEM, STM, and Auger analysis, and found that they are stable up to $1200K$, UHV compatible and exhibit metallic conductance. Further analysis focusses on this transition from the macroscopic to the mesoscopic structures.

MM 29.2 Thu 10:00 P4

Integration of nanowires into microstructures by thin film fracture — •Seid Jebril, Mady Elbahri, and Rainer Adelung — Christian Albrechts Universitaet kiel

Microstructured PMMA- silicon substrate show a foot step in the formation of well aligned cracks. These microstructures were done by conventional lithography. The cracks are formed as a result of thermal stress. The shape of the microstructure affects the strain and stress concentration and creates predetermined fracture points which later relax via cracks. The cracks that are formed in such a manner serve as a template for the formation of nanowires, which are fabricated by metal deposition and consecutive mask lift-off. We report that channels made by conventional lithography can have a great influence on the control of the alignments of nanowires. These alignments can be precisely controlled by tailoring the width of the channels. When the channel in the order of around 10 microns, a regular zigzag nanowire pattern was observed. For example 20 Platinum nanowires with a zigzag fashion and aligned by 45 degree were fabricated in channels of 10 micrometer width and a length of 200 micrometer. These nanowires were connected end to end across the length of the channel with contacts. By tailoring the channel width, it is possible to control the alignment of the wire pattern in a desired way.

MM 29.3 Thu 10:00 P4

Reaction pathways of a regular disintegration of nanowires by thermocapillarity — •Lars Röntzsch and Karl-Heinz Heinig — Foschungszentrum Rossendorf, Dresden

Surface free energy minimization leads to morphological changes of wires, e.g. disintegration into a droplet chains (Rayleigh instability). At the nano-scale, capillary effects are much more pronounced than in macroscopic systems due to the large surface-to-volume ratio. However, capillary-driven self-organization processes are subject to increasing fluctuations with decreasing dimensions, which mostly prevent the formation of regular structures with long-range order. In this contribution, we predict by means of kinetic Monte Carlo simulations a novel method to fabricate size-controlled chains of nanodroplets. Our prediction rests on the temperature dependence of surface tension - the origin of thermocapillarity. Uncompensated forces occur due to surface temperature gradients. A surface tension gradient triggers the biased migration of atoms from hot to cold regions by surface diffusion. A periodic temperature gradient along a nanowire might be achieved by a surface-plasmon-polariton wave. Thus, long-range regularity of nanodroplet chains, that form during a self-organized disintegration of nanowires, might be considerably improved.

MM 29.4 Thu 10:00 P4

Fabrication of metal nanowires and their hydrogen sorption — •Sönke Schmidt and Astrid Pundt — Institut für Materialphysik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

Nanowire arrays of different metals (Pd, Fe, Nb, V) were produced by small angle sputtering on facetted sapphire, using the self shadowing effect of the facets. Minimum wires widths of about 50 nm were achieved. The wire length is given by the length of the facet. However, in case of Pd, Nb and Fe, island growth was found on the facets backside. The behaviour of Niobium wires during the exposure to hydrogen was investigated with AFM, using Contact mode, Lateral Force Microsopy (LFM) and Force Spectroscopy (FS), as well as Non-Contact mode. Resistivity measurements on Palladium wires arrays during hydrogen loading were carried out. The influence of hydride formation on the resistivity of wires will be discussed.

MM 29.5 Thu 10:00 P4

Quantum size effects and phase transitions in bismuth nanowires — •R. Lovrincic[1], T. W. Cornelius[2], M. E. Toimil Molares[2], S. Karim[2], R. Neumann[2], A. Pucci[1], and G. Fahsold[1] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, 69120 Heidelberg — [2]Gesellschaft für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

We investigate the IR-optical properties of bismuth nanowires (Bi-NW). The wires were prepared at the GSI in Darmstadt by template directed growth of Bi in etched ion tracks [1] and then dispersed on silicon wafers for IR-spectroscopic measurements under UHV-conditions. When the wire diameter is in the same range as the de Broglie wavelength of the conduction electrons, quantum size effects (QSE) occur and the energy bands split into subbands. As the electrons in Bi have a Fermi wavelenght of 40nm, the energy change due to QSE in Bi-NW is measurable for relatively thick wires [2]. We report on a shift of an absorption edge that is proportional to 1/dˆ2 while varying the diameter from 300 to 40nm. This blueshift is attributed to an increasing direct band gap. In addition we studied the thermal stability of these NW. During heating up, a strong jump in IR-transmission occurred which can clearly be attributed to the semimetal-metal transition at the melting point of bismuth. While cooling down, this jump occurred at a 100K lower temperature which can be explained within nucleation theory.

References

[1] T. W. Cornelius et al., Nanotechnology 16 (2005), 246. [2]Y.-M Lin et al., Phys. Rev. B. 62 (2000), 4610

MM 29.6 Thu 10:00 P4

Resonant metal nanowire excitation in the infrared — •F. Neubrech[1], S. Karim[2], F. Kost[1], T. Kolb[1], R. Lovrincic[1], R. Neumann[2], A. Pucci[1], and G. Fahsold[1] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg, INF 227, 69120 Heidelberg — [2]Gesellschaft für Schwerionenforschung, Planckstr. 1, 64291 Darmstadt

We analyse IR spectroscopic properties of single metal nanowires (Cu, Au) and compare the experimental results with simulations of electromagnetic scattering by a perfectly conducting wire. The nanowires with diameters from 50 to 200 nm are prepared by electrochemical deposition in polymeric etched ion track membranes [1]. After dissolution of the membrane, the single wires are put on an IR transparent KBr substrate for spectroscopic measurements, the most of which are performed with the IR microscope at the synchrotron light source ANKA. Spectroscopic microscopy allows to investigate single nanowires of a well defined length, volume, and orientation. We measured the IR transmission in the range from 700 cm-1 to 7000 cm-1 on nanowires with different diameters and lengths. For few micrometer long nanowires we see antenna-like resonances that depend on size and shape of the wires are in good agreement with our calculations. [2]

Due to an antenna-like resonance the enhancement of the electromagnetic nearfield is expected. For an experimental proof, we evaporate a thin paraffin layer on and around the wire and analyse the enhancement of vibration lines.

[1] M.E. Toimil Molares et al., Nanotechnology 15 (2004), 201

[2] G. Fahsold et al., ANKA annual report (2004).