MM 23: Nano structured materials I

Time: Wednesday 14:45–16:15 Location: H4

MM 23.1 Wed 14:45 H4

New method for single wall carbon nanotube growth — •Petr Nozar[1], Roberto Danieli[2], Viliam Vretenar[1], Riccardo Lotti[2], and Carlo Taliani[1,2] — [1]Istituto per lo Studio dei Materiali Nanostrutturati, CNR, Via P. Gobetti, 101, 40129 Bologna, Italy — [2]Organic Spintronics, Srl, Via P. Gobetti, 101, 40129 Bologna, Italy

In the present contribution we report on a novel preparation method for Single Wall Carbon Nanotubes (SWCNT). The procedure is based on brand-new system of Pulsed Plasma Deposition (PPD) developed by Organic Spintronics, Srl. PPD for SWCNT growth represent a synthesis of methods based on a production of catalyst nanoparticles (nickel-cobalt) by plasma heating and CVD ones. The SWCNTs obtained by reported procedure are isolated (not in bundles) with very narrow distribution of diameters and almost free of amorphous carbon and graphite impurities.

MM 23.2 Wed 15:00 H4

Nanowire Devices formed by Wet Chemistry — •Mady Elbahri, Khaled Hirmas, and Rainer Adelung — Chair for Multicomponent Materials, Technical Faculty, University of Kiel, Germany

The electronic structure of polycrystalline nanowires is modified if molecules attach on their surfaces. Employing this effect, sensor demonstration devices have been built. For example, interparticle boundaries of metallic nanowires have been used to sense different gases [1]. Semiconductor nanowires can be utilized as gates in field effect transistors to detect electric fields caused by atoms around them [2]. Even though these demonstrators show the potential of nanowires in sensing technology, simple and cost effective methods suitable for mass fabrication are still not established. Surprisingly, we found that nanowires formed by wet chemical methods [3] can be reproducibly aligned with high precision. Therefore, the nanowire fabrication is not performed in a beaker, but directly on a silicon chip surface. By using masks with relatively large structure sizes (>0,05 mm), we show how wet chemically produced metal (Ag) as well as semiconducting (ZnO) nanowire patterns like rings and arrays of parallel wires form at well defined positions on a silicon chip surface. Beside the details of the fabrication scheme, the electrical and electronic properties of the devices will be discussed.

[1] B. J. Murray, E. C. Walter, and R. M. Penner, Nano Lett. 4, 665, (2004). [2] F. Patolsky and C. M. Lieber, Mat. Today 8(4), 20 (2005). [3] M. Elbahri, R. Adelung, and D. Paretkar, Deutsches Patentamt, DE 10 2005 060 407.2 (2006).

MM 23.3 Wed 15:15 H4

Low temperature synthesis of Zn nanowires by physical vapor deposition — •Philipp Schroeder, Michael Kast, and Hubert Brückl — Austrian Research Centers GmbH ARC, Nano-Systemtechnologies, Donau-City-Straße 1, A-1220 Wien, Austria

We demonstrate catalytic growth of zinc nanowires by physical vapor deposition at modest temperatures of 125-175°C on various substrates. In contrast to conventional approaches using tube furnaces our home-built growth system allows to control the vapor sources and the substrate temperature separately. The silicon substrates were sputter coated with a thin gold layer as metal catalyst. The samples were heated to the growth temperature and subsequently exposed to the zinc vapor at high vacuum conditions. The work pressure was adjusted by the partial pressure of oxygen or argon flow gas. Scanning electron microscopy and atomic force microscopy characterizations revealed that the nanowires exhibit straight, uniform morphology and have diameters in the range of 50-350 nm and lengths up to 70 μm. The Zn nanowires grow independently of the substrates crystal orientation via a catalytic vapor-solid growth mechanism. Since no nanowire formation was observed without gold coating, we expect that the one-dimensional growth is initiated by a surface reactive Au seed. ZnO nanowires can be produced in the same preparation chamber by oxidation at 500°C in 1atm (80% Ar, 20% O2) for 1 hour. ZnO is highly attractive for sensor applications.

MM 23.4 Wed 15:30 H4

Electrical Properties and Oxidation Behavior of Nanowires — •Seid Jebril, Kittitat Subannajui, Mady Elbahri, and Rainer Adelung — Chair for Multicomponent Materials, Technical Faculty, University of Kiel, Germany

The integration of nanowires into silicon chips, microstructured by conventional lithography, is still a difficult task. Either the procedures are costly or they suffer from small throughput. Lately, we suggested a cost effective method based on thin film fracture [1]. We demonstrate that this can be adopted to form reproducible nanowires between micro-contacts formed by standard lithography. Therefore, simple geometrical objects like microstructured photo-resist bars were integrated in a layout of a silicon chip. Exposing the bars to stress leads highly reproducible fracture patterns that are used as templates for a successive nanowire fabrication step. We show microchips containing integrated Au and Ni nanowires. The conductivity behavior as a function of the wire diameter and temperature is discussed, and the changes in current due to field induced as well as normal oxidation of Ni nanowires is investigated.

[1] M. Elbahri, S. K. Rudra, S. Wille, S. Jebril, M. Scharnberg, D. Paretkar, R. Kunz, H. Rui, A. Biswas, R. Adelung, Adv. Mater. 18, 1059 (2006).

MM 23.5 Wed 15:45 H4

Winkelabhängigkeit der Koerzitivfeldstärke bei Nickel-Nanostäben — •Annegret Günther, Stefan Monz, Andreas Michels, Andreas Tschöpe, and Rainer Birringer — FR 7.3 Technische Physik, Universität des Saarlandes, Geb. D 2.2, D-66123 Saarbrücken

Nickel-Nanostäbe wurden mittels des Elektrodepositionsverfahrens in eine poröse Aluminiumoxidschicht abgeschieden. Durch geeignete Wahl der Prozessparameter (Anodisierungsspannung, Stromdichte, Zeit) konnten Stäbe mit einem mittleren Durchmesser D zwischen etwa $15-100\,\mathrm{nm}$, einer Länge L zwischen $50-500\,\mathrm{nm}$ und variablem ("center-to-center") Abstand hergestellt werden. Die Stabensembles wurden mittels Elektronenmikroskopie und VSM-Magnetometrie charakterisiert. Bei den magnetischen Messungen lag der Schwerpunkt auf der Untersuchung der Abhängigkeit der Koerzitivfeldstärke H_C vom Winkel Θ zwischen angelegtem Magnetfeld und Stabachse sowie von den Abmessungen (D und L) der Nanostäbe. Insbesondere galt unser Interesse dabei dem Studium des Übergangs vom "coherent rotation" zum "curling" Magnetisierungsumkehrprozess, der für Ni bei einem kritischen Stabdurchmesser von ungefähr 20 nm erwartet wird.

MM 23.6 Wed 16:00 H4

Field emission properties of bare and gold coated metallic nanowires grown in polymer ion-track membranes — •Arti Dangwal[1], Günter Müller[1], Florian Maurer[2], Joachim Brötz[2], Hartmut Fuess[2], and Christina Trautmann[3] — [1]FB C Physics Department, University of Wuppertal, D-42097 Wuppertal, Germany — [2]epartment of Material and Earth Sciences, Darmstadt University of Technology, D-64287 Darmstadt, Germany — [3]Gesellschaft für Schwerionenforschung (GSI), D-64291 Darmstadt, Germany

We have measured the field emission (FE) properties of randomly distributed free-standing bare and gold coated Cu and Ni nanowires grown electrochemically into the pores of etched ion-tracked polycarbonate membranes [1]. The emission site density and current distribution of nanowires were measured with the field emission scanning microscope. Onset fields of some V/μm for nA current were observed for all samples. In the best case, at 5 V/μm bundled Cu and Au-coated Ni nanowires yielded more than 10ˆ5 emitters/cm2. Average field enhancement factors for all measured samples lie in the range 245-331, which correspond well to the field enhancement estimated from their cylindrical shape in SEM images [2]. Au-coated bundled Cu nanowires sample showed best results among all measured samples in terms of carrying high and stable FE currents, i.e. most of the emitting sites produced FE currents in 10 -35 μA range without destruction.

[1] F. Maurer et al., Nuclear Instruments Methods in Physics Research B 245, 337 (2006).

[2] A. Dangwal et al., subm. to JVST B.