MM 32: Topical Session Multifunctional Materials I

Time: Wednesday 10:15–11:45 Location: H6

Topical Talk MM 32.1 Wed 10:15 H6

Fabrication of TiNi thin film stents — Rodrigo Lima de Miranda, Christiane Zamponi, and •Eckhard Quandt — Kaiserstrasse 2, 24143 Kiel

The success of stents and other medical implants, which conventionally consist of thin walled, laser structured tubes based on superelastic TiNi on the one hand, and the limitations regarding the miniaturization of these medical devices on the other hand, has motivated the application of thin film technology as an attractive alternative approach for some applications, e.g. devices for small vessels.

This work introduce the fabrication and characterization of structured cylindrical TiNi thin films by magnetron sputtering, lithography and wet etching based on previous developments of shape memory alloy films. The TiNi thin films devices fabricated in this work have high potential for application as vascular implants, e.g. stents.

The deposition of TiNi thin films on a cylindrical substrate employs a specific device which allows an in situ rotation of the substrate during the sputtering process. The mechanical properties of the deposited cylindrical TiNi films were tested by tensile testing. Axial and radial directions of the film were tested and both film directions showed comparable mechanical properties with TiNi planar films. Superelastic plateau, closed loop hysteresis and a strain up to 6 % were observed.

Topical Talk MM 32.2 Wed 10:45 H6

First-principles computational design of multifunctional materials — •Arthur Ernst — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle

Development and engineering of new multifunctional materials is one of the main goals in modern condensed matter physics. Thereby, first-principles simulations play a significant role in the design of new materials. Nowadays ab-initio methods based on density functional theory can provide accurate information on structural, electronic, magnetic, and transport properties of realistic systems and has therefore become a major supplement and alternative to experiment.

The presented results are based on multiple-scattering theory which provides explicitly the Green function, which can be used in many applications such as spectroscopy, transport, and many-body physics. Combined with the coherent-potential approximation, this method can be used as well for the description of alloys and pseudo-alloys.

In the talk I will focus on the electronic, magnetic, and transport properties of complex systems like multiferroics, thin metallic films, and oxide heterostructures. The microscopic origin of magnetic and magnetoelectric coupling via interfaces is discussed. The efficiency of the approach is demonstrated.

MM 32.3 Wed 11:15 H6

Towards elastic ceramics and semiconductors — Yogendra Kumar Mishra, Thomas Preusse, Maria Claus, Charline Wolpert, Sebastian Wille, Sören Kaps, and •Rainer Adelung — Functional Nanomaterials, Institute of Materials Science, CAU Kiel, Germany

Designing a material that is elastic and can withstand high temperatures like 1000 °C or more is difficult to design, as polymers do decompose at lower temperatures and metals tend to melt. Especially under ambient conditions, often oxygen creates a problem for metals at these temperatures. Therefore, the design of a flexible ceramic material is desired. If it is at the same time a semiconductor, it has potential as a multifunctional material. In this presentation, we show how a ceramic material has to be organized to show bulk elasticity. In situ experiments show a semiconducting material bended with a manipulation needle in the scanning electron microscope. Furthermore, all details of the fabrication process and the microanalysis understood so far will be presented discussed.

MM 32.4 Wed 11:30 H6

Nanowire-based sensors for chemical species — •Dawit Gedamu, Maria Kassab, Seid Jebril, and Rainer Adelung — Kaiserstr. 2, 24143 Kiel

ZnO has been given lots of attention as it is promising multifunctional material for various applications because of its large direct band gap of 3.37 eV at room temperature and large exciton binding energy of 60 meV. Change in electrical conductance of ZnO thick film , nanostructures , nanowires is reported when such structures are exposed to different chemical species. In this work, a nanowire of ZnO was chosen since such structure has an immense surface area to volume ratio. A suitable and cost effective approach called thin film fracture approach is used to fabricate the nanowire . Under ambient conditions both thin film and nanowire of ZnO deposited by RF sputtering were found to show electrically insulating behavior. Post annealing above 600 K in ambient condition for about 1 hour however has resulted in electrical conductance in both the thin film and the nanowire. When such a nanowire is exposed to oxygen, it shows a quick variation in the electrical conductance for different oxygen concentrations (pressures). Gold (Au) nanowires produced with such a approach were also studied for bio-sensor application. [1] E. S. Jung et al, phys. stat. sol. (b) 244, 5, 1553 (2007) [2] S. Kim and J. Maier Electr. Sol. Stat. Lett. 6 (11), J7 (2003) [3] Chien-Yuan Lu et al, IEEE SENS. J. 9, 4 (2009) [4] S. Jebril et al. Small 4, 2214 (2008).