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## S E M I N A R
## aus
## Halbleiterphysik und Nanotechnologie

**Mo, 18.6.2018, 11:00 Uhr,** Hörsaal für Physik

# "The Role of Strain in Magnetic Sensors"


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Highly sensitive bio magnetic field sensors for medical diagnostics can be designed using miniaturized magnetoelectric composites. Here combined piezoelectric and magnetoelectric responses generate a signal in response to a magnetic field. Piezotronic and magnetoelectric sensors display complex phenomena due to the electronic, magnetic, and crystallographic structure that determine their material functions. The intrinsic strain at coupled components in magnetoelectric composites plays an important role for the properties and function of these materials[2]. Nano X-ray diffraction experiments show both coating-induced and magnetic-field-induced strain behave at the coupled interface of complex magnetoelectric microcomposites[3]. These consist of piezoelectric ZnO microrods coated with an amorphous layer of magnetostrictive $(Fe_{90}Co_{10})_{78}Si_{12}B_{10}$. The strain relaxation distance of just 5 μm for both kinds of strain superposes indicating a correlation. The value of both intrinsic and magnetic-field-induced strain depends upon the diameter of the rod like composites. The intrinsic interface strain within the ZnO increases exponentially by decreasing the rod diameter while the magnetic-field-induced strain increases linearly within the given range. This study shows that miniaturizing has a huge impact on magnetoelectric composite properties, resulting in a strongly enhanced strain field and magnetic response[1]. Preparing a Schottky contact on such ZnO microrods further increases the strain response to mechanical stress. By using piezotronic readout from magnetoelectric sensors, it is possible to increase the limit of detection by three orders of magnitude. This approach will also be discussed.


References


1. *Tunable Strain in Magnetoelectric ZnO Micro Rod Composite Interfaces*
   S. B. Hrkac, C. T. Koops, M. Abes, C. Krywka, M. Mueller, M. Burghammer, M. Sztucki, Thomas G. Dane, S. Kaps, Y. K. Mishra, R. Adelung, J. Schmalz, M. Gerken, E. Lage, C. Kirchhof, E. Quandt, O. M. Magnussen, and B. M. Murphy, ACS Appl. Mater. Interfaces, 9, 25571 (2017)
2. *Direct measurements of field-induced strain at magnetoelectric interfaces by grazing incidence x-ray diffraction*
   M. Abes, C. T. Koops, S. B. Hrkac, H. Greve, E. Quandt, S. P. Collins, B. M. Murphy and O. M. Magnussen, Applied Physics Letters, 102, 011601 (2013)
3. *Local magnetization and strain in single magnetoelectric microrod composites*
   S. B. Hrkac, M. Abes, C. T. Koops, C. Krywka, M. Mueller, S. Kaps, R. Adelung, J. McCord, E. Lage, E. Quandt, O. M. Magnussen and B. M. Murphy Applied Physics Letters, **103**, 123111 (2013)