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Stress induced deformation in piezotronic micro structures studied by X-ray nano diffraction

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One promising approach to design bio magnetic field sensors is to combine piezoelectric and magnetostrictive materials in a magnetoelectric composite. Such sensors have the ability to generate an output in response to a magnetic signal from for example the human body. To achieve the extreme sensitivity of less than 100 pT required for medical applications, is a challenge. By using piezotronic readout from magnetoelectric sensors, it is possible to increase the limit of detection by three orders of magnitude. The piezotronic effect occurs in semiconductors with a non-centrosymmetric crystal structure. An induced piezoelectric potential causes additional piezoelectric charges at the metal-semiconductor interface resulting in a change of height and width of the Schottky barrier. The charge carrier transport across the metal-semiconductor contact is therefore dependent on the piezoelectric charges, which can be controlled by the magnitude and sign of the applied strain or vice versa. For this experiment we used ZnO micro wires with diameters between one and 100 µm. We collected the electronic responce of the sample and simultaneous applied a mechanical stress while observing key Bragg reflections. This nanofocus diffraction experiment provided a unique possibility to determine the spatially resolved lattice deformation in the device during piezotronic measurements.

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