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51st Internationales Wissenschaftliches Kolloquium
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First steps towards a nanowire-based electromechanical biomimetic sensor

Since much research is done concerning the application of the bottom-up approach in novel device concepts, nanowires of any material have recently gained much attention. In the course of that development, many devices based on the unique electrical and optical properties of nanowires have been designed and made. However, up to date there are only few studies on the mechanical properties and no functional mechanical devices except resonator structures.

We propose the development of a basic module for novel nanowire based nanoelectromechanical devices which will require the mechanical coupling of nanowires to a transducing structure. Freestanding nanowires grown on a AlGaN/GaN heterostructure containing a two-dimensional electron gas (2DEG) serve as basic structure, which can be employed for both, the characterization of the mechanical properties of nanowires and for a new kind of sensor structure. The intended read-out is based on the change in the electric conductivity of the 2DEG under the influence of external mechanical forces.

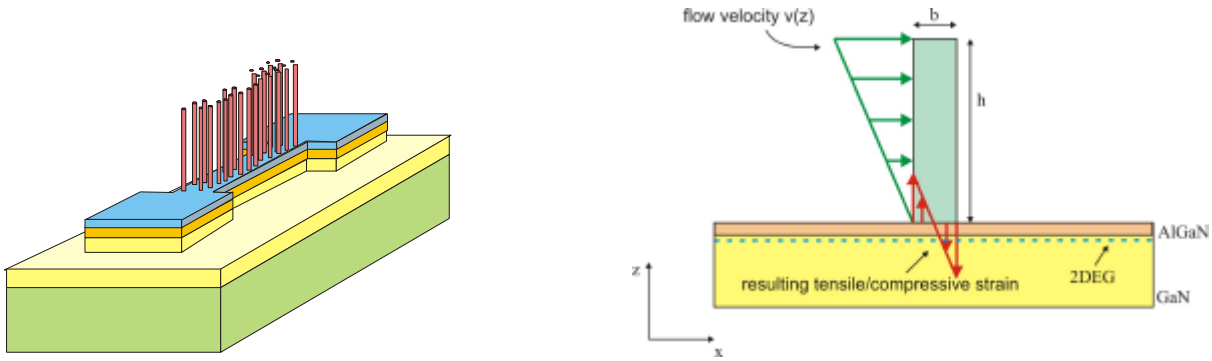

Fig. 1: Schematic drawing of the sensor structure (left), and the underlying theoretical model (right).

Here we present the technology necessary for patterning AlGaN/GaN mesa structures and first studies concerning the controlled growth of silicon nanowires in general and their localized growth on previously patterned substrates.

The deflection of nanowires affects the strain at the interface between the nanowire and the heterostructure surface, which induces a change of the conductivity of the 2DEG below the AlGaN barrier. Based on this structure fundamental research concerning the mechanical properties of the nanowires as well as their adhesion and coupling to the substrate becomes possible, which is a first step towards new sensor concepts which will mimic biological systems such as the human equilibrium organ. If this structure is finally placed into a microfluidic cell, any movements of the surrounding liquid caused by constant flow as well as by tilting the whole microfluidic cell can be detected via the deflection of the nanowires and the force they apply to the transducing structure underneath.

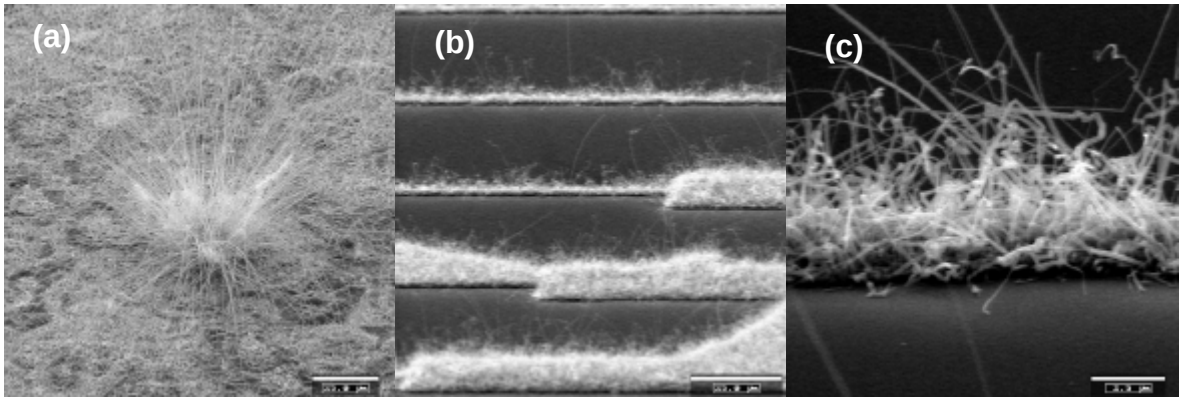

Fig. 2: Silicon nanowires on glass (a), silicon nanowires on prepatterned structures (b, c).

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