Sensing with Schottky barrier based silicon nanowires FET

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Abstract
Nanomaterials have entered the phase of commercial applications [1] in medicine as drug carriers or labels [2], contrast agents for magnetic resonance imaging [3], and convenient tool for biodetection. Some of the prominent examples are the use of nanoparticles in combination with fluorescent labels for large number of biochemical tests or a new class of biological sensors, relying on semiconducting nanowires [5], for detection of biological molecules or of products of biologically catalyzed reactions. In contrast to already conventional optics-related biodetection methodology, the alternative concept utilizes the measurements of the electrical signals, *i.e.* electrical resistance [6]. For instance, conductance of the nanometer sized field effect transistors can be affected by an electric field of the target molecule adsorbed on its surface [5]. This novel approach offers advantage of the real-time and label-free detection of the analytes in liquid samples, whereas most of standard biochemical methods require the use of labels.

Here we introduce the first bottom-up grown Schottky barrier silicon nanowire field effect transistors for liquid sensing applications (see Figure 1). As a first application, the sensing effect is demonstrated for changing pH values. In particular, we are addressing three main issues: (i) bottom-up fabrication of high-quality silicon nanowire (SiNW) FETs, which allow an integration into non-silicon systems; (ii) high-current sensing for low-cost electronic measurements of ion-sensitive field effect transistors (ISFETs) devices by assembling large numbers of nanowires [7] into a single ISFET; (iii) investigations of charge sensing sensitivities, allowing quantitative statements on the sensor quality and pH values, which can be further developed to sensing concentrations of biological molecules. A novel type of online measurement for the determination of threshold voltage and other parameters during the experiment is introduced.

References

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Figures

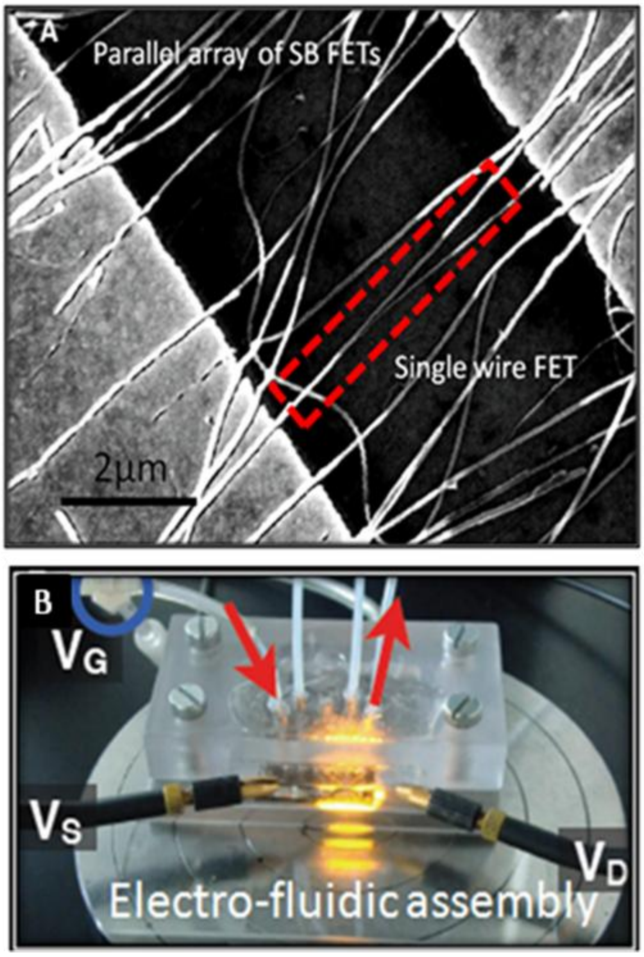

Figure 1 Sensor platform based on silicon nanowires FETs: (a) device consisting ofparallel array of undoped silicon nanowires and nanosized Schottky junctions; (b) Microlfuidic chip for sensing measurements.