Universität Basel

Research Project

Integrateable Silicon NANOWIRE SENSOR Platform

Third-party funded project

Project title Integrateable Silicon NANOWIRE SENSOR Platform
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Field-effect transistors made from semiconducting NANOWIRES (NWs) have a great potential as electronic BICHEMICAL-SENSORS if they can be integrated as an array in a CMOS-compatible architecture together with microfluidic channels and interfacing electronics. In addition to the expected high sensitivity and superior signal quality due to on-chip correlation analysis in time and space, such NW sensors could be mass manufactured at reasonable costs and readily integrated into electronic diagnostic devices to facilitate bed-site diagnostics and personalized medicine. Finally, their small size make them ideal candidate for future implanted sensing devices.

In this project we will develop a silicon nanowire-based field-effect transistor sensor platform which is applicable to label-free multiscale screening with full electronic processing and read-out capability due to silicon integration. We propose to work on nanowires etched directly into silicon (Si). This will be done along two directions: a) NWs formed by etching into SIO (Si-on-insulator) wafers and b) tri-gate body-tied nanowire structures obtained by a combination of oxidation and etching. We will start with the fabrication of single nanowires and small arrays of nanowires to characterize their electrical properties. The respective microelectronics unit will be developed in parallel, initially a two-chip solution will be pursued.

In a second stage, we will extend the production of nanowires to a wafer-scale process while grouping the optimized nanowires in pixel units (arrays of wires). The NWs will be chemically functionalized. A particular emphasis will be laid on the selective functionalization of individual or groups of NWs. The sensing capability will be validated using (bio)chemically functionalized NWs to target a) environmental monitoring in air and solution, b) small molecule screening in model solutions and c) specific biomarkers with receptor-functionalized nanowires for biologically and/or medically relevant systems.

During the final phase of the project, arrays of NWs will be fabricated and tested as a biosensing platform. After validating the approach with conventional and well known biological agents (such as the biotin-avidin system), we will target a more specific medically and pharmacologically relevant system. As a representative test system, a lectin/carbohydrate interaction will be explored. This type of interaction was identified, in the last decade, as the initial point for a vast number of biologically important processes and thus offers numerous opportunities for novel therapeutic interventions, e.g. in inflammatory diseases, neural regeneration or bacterial and viral infections.

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