SILICON-BASED FIELD-EFFECT STRUCTURES – FROM DIELECTRICS TO BIOELECTRONICS

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Microfabricated semiconductor devices are becoming increasingly relevant also for the detection of biological and chemical quantities. Therefore, the techniques of preparation of such (bio-)chemical sensors will have a crucial impact in different fields of application such as medicine, food technology, environment, chemistry and biotechnology as well as information processing. Scientists and engineers are interested in the analytical benefits of miniaturised and microfabricated (bio-) chemical sensors. In this presentation, novel concepts for silicon-based sensors are introduced and selected examples are discussed:

- Thin dielectric films with thicknesses in the nm-scale serve as sensor membranes for ion-selective sensing; the dielectric materials of Al_2O_3 and Ta_2O_5 have been fabricated by means of pulsed laser deposition technique.
- The chemical (cross-linking) and physical (within three-dimensionally structured Si transducer materials) immobilisation of biomolecules, like enzymes, allows the realisation of field-effect-based enzyme biosensors for biotechnological process control as well as pharmaceutical and environmental monitoring.
- Multi-parameter detection of (bio-)chemical as well as physical parameters has been realised by using a hybrid FET-based transistor module that is based on an identical transducer principle.
- The development of biohybrid sensors by immobilising living cells or intact chemoreceptors to silicon field-effect transistors as electrical transducers will be introduced.

All the developed sensor approaches take benefit from a hybrid/modular concept, i.e. due to their exchangeability, they become subject of completely miniaturised systems for (bio-)chemical analysis such as µTAS or “lab on a chip”.