

Editorial

Application of field-effect transistors (FETs) as sensitive elements in chemical analysis was introduced by P. Bergveld more than 30 years ago. Metal-oxide-semiconductor FET (MOSFET) was an electronic precursor of chemically sensitive FETs. In order to provide chemical sensitivity of FETs, a metallic layer was separated from the isolating gate oxide and placed in a solution as a reference electrode. This provided an isolating oxide/solution interface sensitive to the chemical composition of the solution. An interfacial potential generated by chemical means on the isolating oxide/solution interface governed the conductivity of the semiconductor layer below the isolating oxide, thus allowing the electronic transduction of the chemical signal appearing at the oxide/solution interface. Various processes resulting in the formation of this interfacial potential were used to provide the chemical sensitivity of the FET devices. In the first studied devices, the oxide surface provided hydroxyl groups capable to dissociation/protonation equilibrium, thus resulting in different potentials upon varying a pH-value of the analyzed solution and, thus, yielding pH-sensitive FET devices. Integration of ion-selective membranes with the isolating oxide surfaces resulted in numerous ion-selective FETs (ISFETs). In these devices the interfacial potential on the gate surface is controlled by a concentration of a specific ion that interacts with the respective ion-selective membrane. Recent advances in supramolecular and polymer chemistry provided new systems with the high selectivity of guest/host molecular interactions, which could be used for the development of novel ion/molecular-sensitive FET devices. Particularly, molecularly imprinted polymers are promising sensing matrices for chemically sensitive FET

devices (CHEMFETs). Integration of the FET sensing interfaces with biocatalytic or biorecognition systems generating the interfacial potential upon the specific biochemical processes resulted in the development of novel biosensors. Enzyme-based FETs (EnFETs) and more recently DNA-functionalized or antigen/antibody-functionalized gate interfaces were used to develop numerous enzyme-based biosensors, DNA sensors and immunosensors, respectively. The rapidly progressing area of biomolecular electronics provided the important knowledge and tools for the assembling of biomolecules on the sensing interface, and complex architectures, which include enzymes, cofactors and electron-relays, were generated on the gate surfaces. In addition to the direct current measurements on the FET devices, alternative current techniques, e.g., transconductance measurements, were applied to characterize the biomolecule-functionalized gate surfaces. Rapid progress in nanotechnology in the last years resulted in the development of nano-sized FETs based on semiconductive carbon nanotubes and some other nano-objects. The recently discovered nano-FETs were already combined with biomaterials in order to design nanodevices for sensing of biorecognition events and biocatalytic processes. Thus, in the last 30 years, the first pH-sensitive FETs were developed to the devices with the complex molecule/biomolecule architectures associated with the sensing gate providing the variety of sensors/biosensors. Further miniaturization from the micro-scale to the nano-scale became possible. The present special issue of *Electroanalysis* attempts to present various facets of the area, particularly related to biosensors based on FETs. I would like to thank all the authors who contributed to this issue.

Eugenii Katz, Guest Editor