

Integrated biosensing for diagnosis and therapy

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Abstract

Monitoring human metabolism is of crucial importance for personalized medicine. Many metabolic diseases can be treated by controlling various endogenous metabolites (e.g., glucose, lactate, cholesterol, etc.). Similarly, measuring the metabolism of exogenous compounds (e.g., etoposide, flutamide, cyclophosphamide, etc.) can enhance the effectiveness of a therapy as applied to the individual patient, since the response rate of different patients to the same pharmacological treatment and dose typically varies widely. The objective of this work is the systematic study of the use of electrochemical readout for advanced diagnosis and drug monitoring. Whereas to date various electrochemical principles have been studied and successfully tested, they typically operate on a single target molecule and are not integrated in a full data measurement and analysis chain. Our work addresses simultaneous multi-target detection as well as full integration of biosensors and readout electronics in silicon-based realizations that can be implanted in animals and humans. Our sensors exploit as probes both the protein class of oxidases - for sensing endogenous metabolites - and cytochromes P450 - for sensing drug compounds. We fabricated nanostructured electrodes that use carbon nanotubes (CNT) as intermediary between the probes and the electrodes to achieve higher sensitivity and lower detection limit and we developed circuits for in-situ data analysis. We developed an integrated platform to support multiple applications within the same architecture, thus extending the scope of utilization of the biosensing analysis chain.

Biography

Giovanni De Micheli is Professor and Director of the Institute of Electrical Engineering and of the Integrated Systems Centre at EPF Lausanne, Switzerland. He is program leader of the Nano-Tera.ch program. Previously, he was Professor of Electrical Engineering at Stanford University. Prof. De Micheli is a Fellow of ACM and IEEE and a member of the Academia Europaea. His research interests include several aspects of design technologies for integrated circuits and systems, heterogeneous platform design including electrical components and biosensors, and data processing of biomedical information. Prof. De Micheli is the recipient of the 2003 IEEE Emanuel Piore Award for contributions to computer-aided synthesis of digital systems. He received the Golden Jubilee Medal for outstanding contributions to the IEEE CAS Society in 2000. He received the 1987 D. Pederson Award for the best paper on the IEEE Transactions on CAD/ICAS, two Best Paper Awards at the Design Automation Conference, in 1983 and in 1993, and a Best Paper Award at the DATE Conference in 2005. He has been serving IEEE in several capacities, namely: Division 1 Director (2008-9), co-founder and President Elect of the IEEE Council on EDA (2005-7), President of the IEEE CAS Society (2003), Editor in Chief of the IEEE Transactions on CAD/ICAS (1987-2001). He has been Chair of several conferences, including DATE (2010), pHealth (2006), VLSI SOC (2006), DAC (2000) and ICCD (1989).