P450 Based Nanochip Arrays for Diagnostic Applications In Personalized Therapy

Contact person: **Andrea Cavallini** (andrea.cavallini@epfl.ch)
Sandro Carrara (sandro.carrara@epfl.ch)

Presentation:

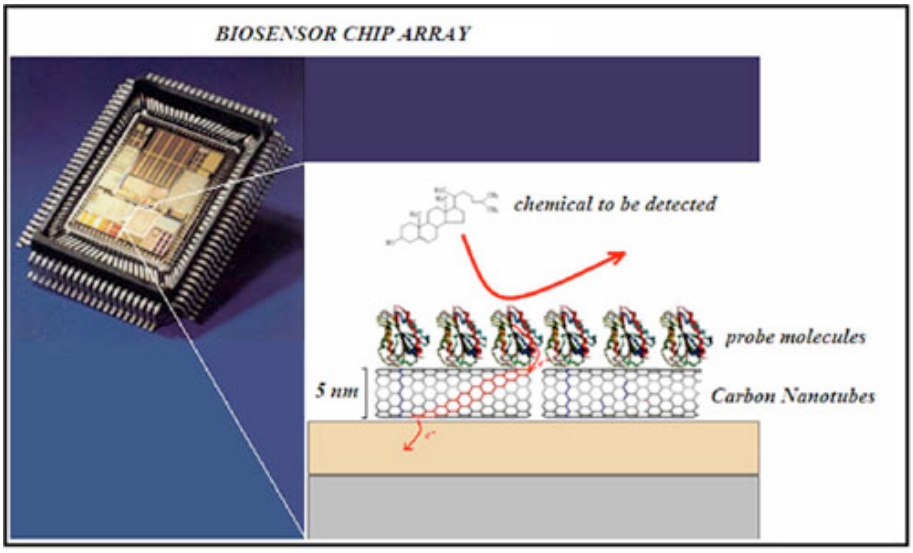
The development of new technologies in personalized therapy is required to increase the fraction of patients that can benefit at best from pharmacological treatments. Average rate of efficacy of drug therapies ranges, for many of the major pathologies, from 20 to 60%; moreover, approximately 7% of hospitalized patients experience serious adverse drug reactions. For this reason, drug therapy needs personalization to the individual patient.

At present, the only strategy for personalization of drug therapies is to check the genetic predisposition of patients. Even if this technology represents a great improvement with respect to the traditional approach, the sole knowledge of genotype is not sufficient to achieve the maximum accuracy in drug administration, since human metabolism may vary in short time periods and it is related to patients' nutrition, history, attitudes, and environmental conditions. Drug metabolism needs monitoring on a daily basis for the optimization of any ongoing drug therapy. A reliable low-cost technology to monitor multiple drug compounds in patients for personalized treatments can be developed using cytochromes P450 as probe proteins.

Goal:

The objective of this thesis is to develop an implantable, nanotechnology based, biosensor for drug metabolism analysis, which significantly improves the quality and reliability of drug concentration measurements, providing at the same time a reduction in the cost and time of analysis. In particular, the system will quantify concentrations of drugs and substrates metabolized by cytochrome P450 enzymes.

P450's have a key role in the metabolism of drugs and can represent a potential target for the development of platforms for personalized therapy. Enzyme Biosensors based on a variety P450 proteins have already been developed, however the detection of drug mixtures with enzyme biosensors represent an innovation. Multiple drugs detection with cytochromes is a challenging task because different P450 isoforms are not selective for a single compound, and are subjected to several atypical kinetic features that will affect the protein efficiency according to the concentration and the type of the drugs present in the sample analyzed.



Concept drawing of a platform for drug metabolism analysis based on multiwalled carbon nanotubes and cytochromes P450

Publications:

Carrara, S., Cavallini, A., De Micheli, G., Olivo, J., Benini, L., Shumyantseva, V., Archakov, A., "Circuits Design and Nano-Structured Electrodes for Drugs Monitoring in Personalized Therapy", in proceedings of IEEE BioCAS 2008, Biomedical Circuits and Systems Conference, Baltimore, 20-22 November 2008, pp. 325-328, ISBN: 978-1-4244-2879-3/08

Carrara, S., Cavallini, A., Garg, A., De Micheli, G., "Dynamical Spot Queries to Improve Specificity in P450s based Multi-Drugs Monitoring", proceedings of the IEEE/ICME International Conference on Complex Medical Engineering, April 9-11, 2009, Tampe, Arizona, U.S.A.

Carrara, S., Cavallini, A., De Micheli, G., "Multi-panel Drugs Detection in Human Serum for Personalized Therapy", Biosensors 2010, May 26,28, Glasgow, UK