Advances in biosensing: from electrochemical impedance spectroscopy (EIS) to Localized Surface Plasmon Resonance (LSPR), surface acoustic waves (SAW) and beyond

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In recent years, the development of innovative and versatile sensing technologies found application in different fields such as medicine, agriculture, food safety, environmental and industrial monitoring. A wide range of strategies were employed in literature. In this respect, we will report and compare different read-out approaches that we exploit in our laboratories in response to specific needs for several biological applications.

Electrochemical impedance spectroscopy (EIS) allows the development of multipurpose biochips suitable for (1) monitoring cell viability, cytotoxicity, migration and proliferation as well as drug-induced cell behaviour *[1, 3]*, (2) the ultrasensitive detection of biomarkers for cancer diagnosis in serum samples, toxins/allergen, pathogens and contaminants in food and the environment *[4-6]*. Recently, such impedance chips have been modified for detection of plant diseases such as Grapevine leafroll-associated virus 3 *[5]* and gas sensing *[7]*.

In the case of small molecules, more complex and sensitive read-out schemes can be preferable. For this purpose, we also investigate alternative strategies based on (1) surface acoustic waves (SAW *[6]*), (2) Localized Surface Plasmon Resonance (LSPR) *[8]*, (3) Split ring resonators *[9]* and (4) magnetoresistive sensors *[10]*.

Results from the Lab on Chip (LoC) platform are in good agreement with the output of standard assays. We demonstrated that the miniaturized platform presents several advantages in terms of reagents consumption, operator time and assay costs, portability, scalability and automated sample handling.

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