13: Electronic tongue: principle, construction and analysis for complex mixtures

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Electronic noses/tongues (eN/eT) are devices inspired by the mammalian olfactory system, where an array of cross-reactive receptors creates patterns to identify individual analytes or mixtures. Rather than requiring specifically designed binding interactions between receptors and analytes, as is the traditional lock-and-key approach to sensing, such as biosensors and biochips, each differential receptor responds to each analyte to a differing degree. Therefore, identification of an analyte cannot be accomplished from the response of a single receptor; however, a distinct pattern of responses produced over all differential receptors can provide a fingerprint that allows classification and identification of the analyte. Comparing to classical biochips, eN and eT represent a definitive advantage for analysis of complex mixtures. Generally, the term eN is used for devices designed for gas sample analysis and eT for liquid samples.

The eN/eT systems include three major parts: an array of sensing elements, a detection system and a computing system for data processing. The choice of the sensing materials is critical for the good performance of the system. As for the detection system, the most common are electrochemical or optical ones. Surface plasmon resonance imaging (SPRi) is an optical surface sensitive technique that probes changes in the refractive index of less than 0.0001 or the thickness of thin films of less than 1 nm with a spatial resolution of approximately 2 µm, and thus is well suitable to monitor the molecular interactions in real time for electronic tongue device. By data processing the samples can be differentiated or classified based on pattern recognition.

The aim of this practical work is to learn the principle of eT, to construct a microarray for electronic tongue (*1/2 day*), to analyze complex mixtures, such as red wine, milk and coffee, with the help of an optical detection system SPRi, finally to differentiate and/or classify these samples by data processing (*1/2 day*). It will be based at the Institute of Nanosciences and Cryogenics (INAC) at CEA Grenoble.

Studies level requested to follow this practical: Master of Science in Chemistry, Biochemistry, Physics or Material's Science.

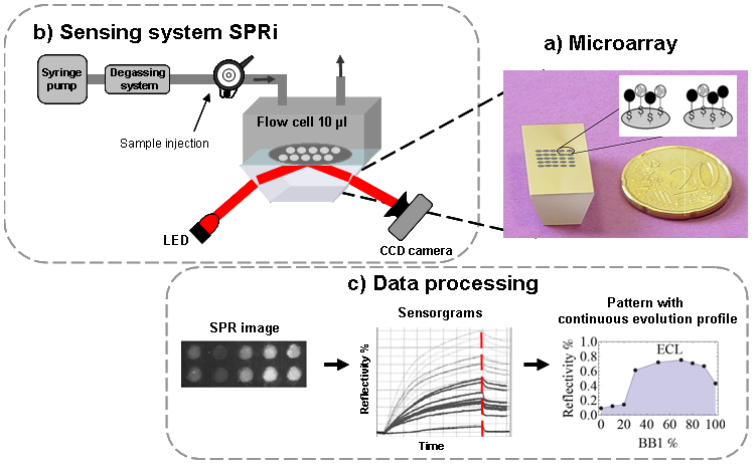

Figure 1: Schematic illustration of the electronic tongue composed of a) a microarray and b) an optical detection system SPRi. c) By data processing, the electronic tongue can generate a pattern with continuous evolution profile for each sample, which behaves like a fingerprint suitable for differentiation and identification of the complex mixtures.