N°13: Electronic nose: principle and analysis for odors

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Today, there is a growing demand for sensitive and selective detection of odors, or volatile organic compounds (VOCs) in various domains such as environment monitoring, public safety, quality control, non-invasive medical diagnostics. However, so far, how to objectively and reliably measure odors remains a great scientific and technological challenge. Traditional methods, such as GC-MS, though accurate and reliable, require expensive equipment and are often time-consuming and laborious. In this context, electronic noses (eNs) have emerged as promising tools for analysis of odors.

Electronic noses are multisensor systems inspired by the mammalian olfactory system, where an array of cross-reactive sensors 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.

The eN 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 eN device. By data processing the samples can be differentiated or classified based on pattern recognition.

The aim of this practical work (1 day) is to learn the principle of eN and the state of the art for eN through a seminar, to analyze some VOCs using an innovative eN recently developed in our laboratory, with the help of an optical detection system SPRi, finally to differentiate and/or classify these samples by data processing. It will be based at the Interdisciplinary Research Institute of Grenoble (IRIG) at CEA Grenoble.

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

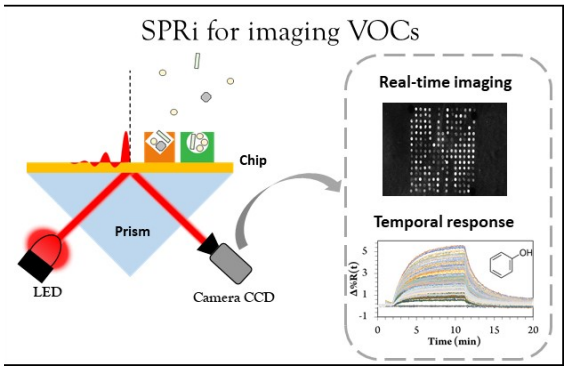

Figure 1: Schematic illustration of the electronic nose composed of a microarray and an optical detection system SPRi. For each VOC, the electronic nose can generate temporal response and an image pattern, which behaves like a fingerprint suitable for differentiation and identification of the samples.