Gas-sensing materials by cooperative self-assembly

Cecília Roque

UCIBIO, Chemistry Department, School of Science and Technology, NOVA University of Lisbon, 29128-516 Caparica, Portugal;

Artificial olfaction is an emerging field aiming to mimic natural olfactory systems. Olfactory systems rely on a first step of molecular recognition where volatile organic compounds (VOCs) bind to an array of specialized olfactory proteins. As a result, electrical signals are transduced to the brain where pattern recognition is performed. An efficient approach in artificial olfaction combines gas-sensitive material arrays with dedicated signal processing and classification tools.

Supramolecular self-assembly provides the possibility to generate modular and tunable materials with stimuli-responsive properties. This field is attracting enormous interest as an approach to functional materials design, and has tremendous, mostly untapped opportunities in creating new types of sensors. We have recently developed the concept of hybrid gels [1]. These materials result from the combination of functional components – liquid crystals for reporting, ionic liquid as solvent, biopolymer as matrix - which give rise to molecular recognition properties not seen in the individual components. Each component has its own role, yet in combination, they provide a molecular environment and compartmentalization that provides the selectivity required for sensing. When casting the hybrid gels as thin films, they exhibited dual optical and electrical stimuli-responsive properties in the presence of VOCs. In this work, films of hybrid gels are studied as gas sensing materials in a custom-built electronic nose. Several features were extracted from the signals obtained upon VOC exposure, and then used to implement a dedicated automatic classifier based on support vector machines for data processing [2]. Furthermore, we show that the developed device can be used in the quantification of ethanol in automotive fuel [1] or in fish spoilage monitoring [3]. The versatility shown by the developed opto-electronic gas sensing materials opens a wide range of applications in different areas such as medical diagnostics, food or agriculture.

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