Extended-Gate-Type Organic Field-Effect Transistors with Self-Assembled Monolayers for Chemical Sensing Applications

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Real samples contain abundant chemical species playing crucial roles in environmental assessments, food analysis, and diagnosis fields. Conventionally, large-sized analytical instruments have been widely applied to real-sample analysis owing to their accuracy. However, the applicability of such a well-established instrumental approach is still a concern in on-site analysis because of the complicated detection principle that requires trained personnel and time-consuming operation. Herein, the presenter introduces an approach for the development of chemical sensor devices based on organic field-effect transistors (OFETs). OFETs are electronic devices showing switching characteristics by applying voltages [1][2]. Owing to the inherent amplification ability, OFETs functionalized with appropriate molecular recognition materials allow sensitive analyte detection over conventional electrochemical sensing methods [3]. Meanwhile, organic semiconductive layers of OFETs are unstable against water, which poses applications for chemical sensing in aqueous media [4]. Thus, an extended-gate structure has been employed to obtain stable signals upon detecting analytes on the gate electrode [5].

Biological materials such as enzymes and antibodies have been employed owing to their favorable specificities to analytes based on the lock-and-key recognition principle. However, detectable analyte structures are limited by a library of these biological materials. Therefore, synthetic receptors based on molecular recognition chemistry are promising approaches in the design of recognition sites. Among them, supramolecular receptors have been vigorously developed in molecular recognition fields. In particular, the cross-reactivity can be applied to simultaneous detection by using pattern recognition methods [4]. Cross-reactive supramolecular receptors are easily modified as self-assembled monolayers (SAMs) on the gate electrode of the OFET [6-8]. This presentation will introduce the design strategy of OFET-based chemical sensors and actual sensing performance in real samples.

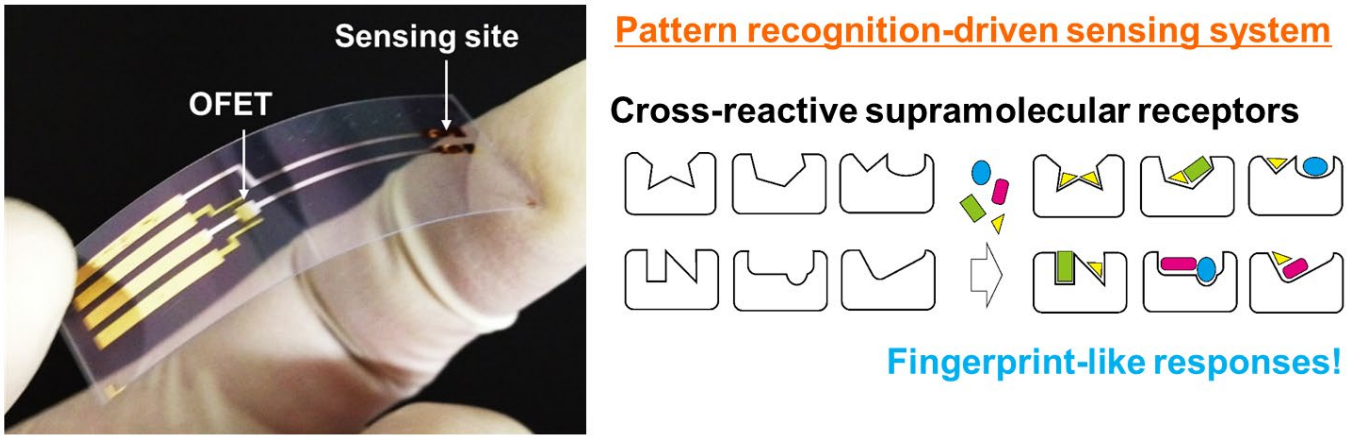

Figure 1: Conceptual figure of an extended-gate-type OFET device functionalized with cross-reactive supramolecular receptors for pattern recognition-driven chemical sensing.

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