

Conducting Polymer FET Nanosensors

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A basic requirement for a chemical or biological sensor is to convert a molecular binding event into a measurable signal. Conducting polymers are attractive for sensor applications because they can directly convert the binding event into an electrical signal. In addition they can be modified chemically with appropriate functional groups for specific recognition and detection of different analytes, and scaled all the way down to the nanoscale or even a single molecule dimension, which provides one with a unique opportunity to study molecular binding events on the nanoscale. Because of these unique properties, many groups have applied conducting polymers to chemical and biosensors.¹⁻³ We present different chemical sensor applications based on nanoscale functionalized conducting polymer junction arrays. Each junction is formed by bridging a pair of gold electrodes separated with a small gap 20–60 nm with polyanilines or PEDOT functionalized with enzymes, oligopeptides or oligonucleotides for detection of glucose, heavy metal ions, nerve agent simulants or RNA sequences (Fig. 1). When an analyte binds the polymer nanojunction modified with the selective recognizing element, it induces a change in the conductance via changes in polymer conformation, local pH or charge distribution. Unique features of the nanojunction array sensors include:

- (1) By reducing the junctions down to nanoscale, the conductance of even a poorly conductive polymer is measurable. This is important because a polymer is often much less conductive once a molecular probe is attached to it, which makes the conductance measurement difficult if one uses films or micron-scale junctions. This is also significant for polymers e.g., polyaniline that are poorly conductive under physiological conditions near neutral pH.

- (2) The nanojunctions have a large surface to volume ratio which rises to extremely high sensitivity and fast response time.
- (3) The reduced dimension requires only small amounts of probes and samples, and promises a highly integrated device.
- (4) When oligopeptides are used as probes, the number of different oligopeptides that can be attached is virtually unlimited by choosing different amino acid sequences which allows one to tune the specificity of the sensor via the combinatorial chemistry approach.

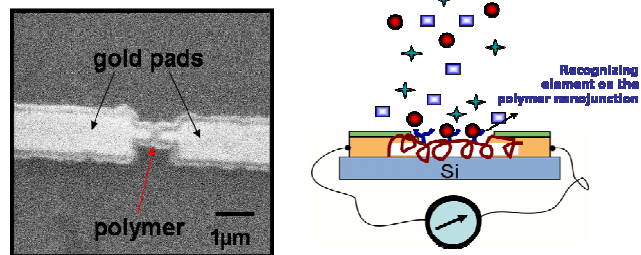


Fig. 1. SEM image of a polymer nanojunction and schematic representation of a recognizing element modified polymer nanojunction for sensing applications.

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