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Impedance for Endocrine Disruption Compounds

Timothy M. Swager

Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139, United States

An unintended consequence of our chemical innovations is the introduction of trace chemicals into our environment that are not necessarily directly toxic, but can impact nature. Mutations in animals/people can happen naturally, but perhaps in many cases human chemical ingenuity is to blame. Our motivations as chemists are honorable, and we have generated pesticides that help us to grow more food, agents to extract hydrocarbons from the earth, and durable materials that can be washed and reused in drinking and baby bottles. Functionally detecting these chemicals in our environment at trace levels, in real time, and in a cost-effective manner has been a challenge. Professor Matthew Francis and co-workers Ariel Furst and Alexander Hoepker have devised a powerful new method to detect suspect compounds known as endocrine disrupting chemicals. In this issue they report a novel assay that can functionally detect suspect compounds that bind to the estrogen receptor α . This approach involves direct electrical detection, which has the benefit of being readily interfaced with a number of existing platforms. Specifically, this team developed electrochemical impedance methods for the detection of endocrine disrupting compounds by using a novel sandwich scheme. Engineered *Escherichia coli* is produced that expresses the estrogen receptor α on its surface, and this structure behaves as a

A new biosensor can report on endocrine disrupting activity through engineered *E. coli*.

very large blocking scaffold that can restrict diffusion of ions to an electrode.

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Live bacteria have mobility and are not as effective as static materials, and as a result they find that this system is most effective with dead, freeze-dried *E. coli*. They modify the electrode surface with a protein that recognizes the estrogen receptor α only when it is bound to an endocrine disrupting compound (Figure 1). The large freeze-dried *E. coli* then becomes immobilized on the surface in the presence of the target compounds to give dramatic changes in impedance. The method is robust and can detect sub-ppb levels of estradiol and ppm levels of bisphenol A in complex backgrounds. The response is functional in nature and reflects estrogenic activity

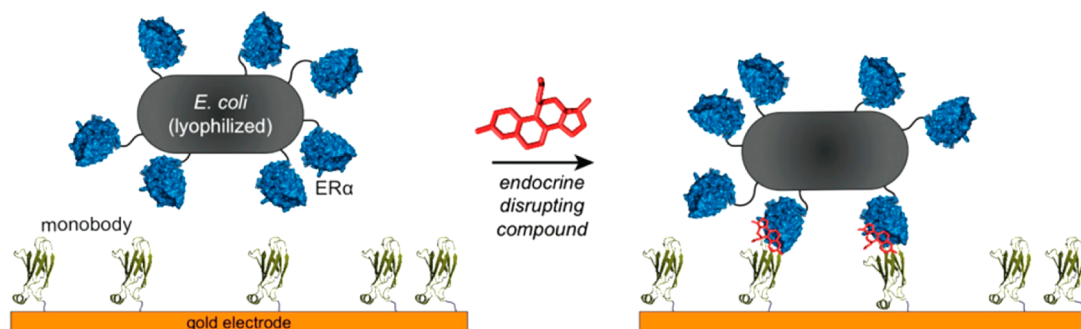


Figure 1. A new biosensor operates through the expression of the estrogen receptor α on its surface which provides a read-out only when an endocrine disrupting compound binds the receptor. Reproduced with permission from ref 1. Copyright 2017 American Chemical Society.

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rather than simple concentrations of compounds. This latter point punctuates the fact that, although we can suspect certain compounds as endocrine disruptors based on their structures alone, a functional assay will best reveal their activity. The rapid nature of this assay and its convenience suggest that this method has excellent prospects for broad adoption.

Author Information

E-mail: tswager@mit.edu.

ORCID

Timothy M. Swager: [0000-0002-3577-0510](https://orcid.org/0000-0002-3577-0510)

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