

# Nano-pairings

Forging molecular detectors from unlikely partners

**R**evealing disease at its earliest onset can provide the best chances of defeating it. Being able to detect extremely low concentrations of biomarkers with nanosensing technology may allow noninvasive detection using saliva—which is derived from blood and contains many of the same biomolecules.

In order to create such nanosensors, Craig Friedrich takes materials that were never formally introduced to each other by natural processes, and make them work together. For example, the optical protein bacteriorhodopsin harvested from the cell membrane of an extremophile bacteria converts light to electrical voltage. When illuminated, this protein is capable of activating microtransistors and quantum-based nanotransistors.

By influencing the activity of the protein upon binding with a target antigen in the environment, such as a toxin or perhaps someday a disease biomarker, a generic nanosensing platform can result. The change in the transistor's output forms the basis of a highly compact and efficient method for molecular detection.

Friedrich's team is developing several methods to modulate the optical protein electrical activity upon molecular binding. One method uses chemically bound quantum dots for nanoscale illumination of the protein. Binding with the target molecule can cause a change in the quantum dot light output and therefore a change in the electrical output of the optical protein and transistor.

A second method fuses a sensing protein directly to the optical protein. Binding with an antigen may cause a large shape change in the optical protein, rendering it inactive. This fused protein-sensing material can be mass-replicated by directing *E. coli* to build the complex molecule.

Both methods hold promise for biomolecular sensing of toxins or potential disease biomarkers. "Perhaps some day a person will be able to buy detection kits off the shelf similar to glucose monitors today," says Friedrich.



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