
The “nanoear” is a form of optical tweezers that can detect sound waves in liquid media from very small objects, including bacteria or other cells that might be producing acoustic vibrations, according to Ohlinger. “With our nanoear, we have developed a nanomicrophone that allows us to get closer than ever to microscopic objects,” he says. The device detects sound levels as low as –60 dB, making it about 1 million-fold more sensitive than the human ear. Its two main components consist of a 60-nm-diameter gold particle and a tungsten needle that is glued onto a loudspeaker. The device is immersed into a water drop, and a laser beam is used to excite optically trapped gold nanoparticles to generate acoustic waves that are detected through photoacoustic microscopy.

The sensitivity of the nanoear will “enable us to access the interior of biological microorganisms and micro-mechanical machines not accessible by other microscopy types,” Ohlinger and his collaborators report. Thus, the nanoear will not so much “listen” as track the motions of cells, cell organelles, and other microscopic objects.

In addition to the moving parts of bacteria, perhaps the German group will consider tracking the movements of the DNA-based motor recently developed by Endo, Sugiyama, Tuberfield, and their collaborators. It is based, in part, on the pioneering DNA origami work being directed by Paul Rothemund at the California Institute of Technology in Pasadena. Origami refers to the Japanese art of folding paper. However, Rothemund substitutes single-stranded DNA molecules, while using synthetic oligonucleotides to hold them in shape.

Following this origami approach, the researchers from Kyoto and Oxford have built a synthetic molecular motor that is fueled through hydrolysis. “It is not only possible to build nanoscale devices that function autonomously, but we can cause such devices to produce predictable outputs based on different, controllable starting conditions,” Endo says. He and his collaborators plan to develop programmable molecular assembly lines and nanosensors.

That research “pushes the envelope of what we can do with molecular robots and our ability to program them,” Rothemund says. “We are working from faith that achieving ever more complex control over molecules is going to give us a tool set that will eventually be useful for creating man-made devices that are as complex as living cells.”

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During Red Tides, Blue Light Triggers Microalgae To Release Brevetoxin

Realizing what triggers microalgae to release brevetoxin during red tides may also lay to rest a misconception regarding the mechanism underlying that release, according to Pedro Verdugo of the University of Washington, Seattle, who collaborated with scientists at Universidad Miguel Hernan-

**Antimicrobial Prospects and Strategies**

Here is news about prospective antimicrobial agents or strategies for handling pathogens:

- **A component in extracts from Chilean avocado plants is an effective inhibitor of bacterial cell efflux pumps, and improves the activity of other antibiotics against pathogens such as Staphylococcus aureus**, according to Sean Brady of Rockefeller University in New York, N.Y., and his collaborators. Details appear online January 5, 2012 in the Journal of the American Chemical Society (doi: 10.1021/ja207662w).

- **A metagenomics approach applied to a mix of soil bacteria unveiled gene clusters for two polyketides, fasamycins A and B, that inhibit bacterial fatty acid biosynthesis, including by pathogens such as S. aureus and Enterococcus faecalis**, according to Sean Brady of Rockefeller University in New York, N.Y., and his collaborators. Details appear online January 5, 2012 in the Journal of the American Chemical Society (doi: 10.1021/ja207662w).

- **Identifying ways to develop host immune tolerance to pathogens offers a “largely overlooked” strategy to reduce damage to humans or other animal hosts from infectious agents**, according to Miguel Soares from Instituto Gulbenkian de Ciência in Portugal, Ruslvan Medzhitov from Yale University School of Medicine in New Haven, Conn., and David Schneider from Stanford University in Stanford, Calif. Details appear in the February 24, 2012 Science (doi: 10.1126/science.1214935).
Red tides arise when *Karenia brevis* dinoflagellates release a set of potent cyclic polyether neurotoxins, known collectively as brevetoxin. The toxins are released in vesicles via exocytosis, a process that occurs in many other types of cells, including in humans. Importantly, the dinoflagellates do not exude these large molecules across their membranes, as had been thought, according to Verdugo. “Nobody knew what exudation was, except a magic word,” he says. “Large molecules cannot go across the membrane in the way that had been proposed. These large molecules in fact are secreted in vesicles, just like the cells in our airway release mucus.”

In the case of the unicellular algae behind red tides, the signal that starts exocytosis is blue light from the sun, according to Verdugo. “We found that if you flash blue light for a few seconds, the organism will start exocytosis.” Blue light penetrates deeper into seawater, perhaps explaining how it serves as a trigger for the release of brevetoxin. “Blue light stimulation implies that these cells must have a photoreceptor, most likely associated with the cell structures known as chloroplasts,” he says. “This is one of the riddles we’ll tackle next.”

While not directly fatal to humans, brevetoxin-containing red tides are toxic to the environment, harming shellfish, other marine animals, and birds that prey on them. “It can affect a fairly large number of species,” Verdugo says. “Microalgae are very important, and produce the same amount of organic food materials as photosynthesis does on land. In fact, microalgae are at the root of most of the nutrients you find in the ocean.”

“Brevetoxin is released as a defense mechanism to poison other higher organisms in the vicinity,” says Corey Smith of Case-Western Reserve University in Cleveland, and chair of the Biophysical Society Exocytosis and Endocytosis Subgroup. “This finding opens many interesting lines of investigation. Can we use this trigger as a molecular tool to enhance our technical study of the release process in mammalian cells? Can our relatively developed understanding of the release process in these organisms be applied to control brevetoxin release during a red tide event?”

**John Otrompke**

John Otrompke is a writer based in Chicago.

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**Developments on the Diagnostic and Detection Front**

Here are several recent developments involving detection of microorganisms and diagnosis of infectious diseases:

- Officials of the Food and Drug Administration in February approved the first breath test for use in children to detect *Helicobacter pylori* infections. The BreathTek UBT test, which is manufactured by Otsuka America Pharmaceutical of Rockville, Md., was approved for adult use in 1996.

- A quick-readout, portable device that uses microbial antigens on microchips to detect bloodborne antibodies is being used to detect tuberculosis in humans and wild animals as well as Johne’s disease in cattle—and could be adapted to detect pathogens in foods, according to Jayne Wu, Shigetoshi Eda, and their collaborators at the University of Tennessee, Knoxville.

- A device, called an integrated microfluidics-waveguide sensor, can sort and count as few as 100 cells/µl of blood or other fluids, and can be used to monitor infections, allergies, and immune disorders, according to Manish Butte of Stanford University in Stanford, Calif., and collaborators. Details appear in the March 7, 2012 *Biomicrofluidics* (doi.org/10.1063/1.3689857).