Electronic nose out in front

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Chemical sensors are exceedingly good at detecting a single substance or a class of chemicals, even at highly rarified concentrations. Biological noses, however, are vastly more versatile and capable of discriminating subtle cues that would confound their engineered counterparts. Unfortunately, even highly trained noses do leave a certain ambiguity when relaying a signal and are not particularly suited for work in specialized situations like operating rooms. A new DNA-based chemical sensor appears to be both extremely sensitive and discerning, making it an important stride on the path to an all-electronic nose.

A team of researchers report in a paper published in the American Institute of Physics' journal *AIP Advances* that specially tailored strands of DNA attached to carbon nanotubes can tell the difference between very similar molecules, even those that have an identical chemical makeup. "We're trying to develop this into an electronic nose system," says A.T. Charlie Johnson, a physicist at the University of Pennsylvania and study co-author. "We used this system to distinguish between optical isomers, molecules that are nearly identical except that one is structurally reversed – a mirror image."

The system works by affixing DNA strands to carbon nanotubes, which are excellent electrical conductors. The DNA strands have been fine-tuned to respond to particular chemicals, so when strands come in contact with a target chemical – even at very low concentrations – it produces a measurable electrical signal along the nanotube. The sensors were able to check for molecules that differ by as little as one carbon atom. Though the researchers are not the first to observe this effect, they have achieved an unprecedented level of differentiation for an all-electronic chemical detector. "What I'm focusing on is the size of the difference in the signal," says Johnson.

The researchers are next interested in creating something akin to an actual electronic nose consisting of many individual DNA-based sensors performing the same role as an olfactory receptor. The goal is to have a system that is highly versatile and sensitive with wide-scale applications. For example, the chemical dimethylsulfone is associated with skin cancer. The human nose cannot detect this volatile but it could be detected with the new sensor at concentrations as low as 25 parts per billion.

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