Nanosensor Arrays 'Smell' Cancer

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(PhysOrg.com) -- In 2006 researchers established that dogs could detect cancer by sniffing the exhaled breath of cancer patients. Now, using nanoscale arrays of detectors, two groups of investigators have shown that a compact mechanical device also can sniff out lung cancer in humans.

Hossam Haick, Ph.D., and his colleagues at the Israel Institute of Technology in Haifa, used a network of 10 sets of chemically modified carbon nanotubes to create a multicomponent sensor capable of discriminating between a healthy breath and one characteristic of lung cancer patients. This work appears in the journal Nano News. Meanwhile, Silvano Dragonieri, M.D., University of Bari, Italy, and his colleagues used a commercial nanoarray-based electronic “nose” to discriminate between the breath of patients with non-small cell lung cancer and chronic obstructive pulmonary disease (COPD). These results appear in the journal *Lung Cancer*.

The key development in Dr. Haick’s team’s work demonstrated that the electrical resistance of carbon nanotubes coated with nonpolymeric organic layers changes substantially when nonpolar organic molecules, such as those present in a breath, pass over the nanotubes. Uncoated nanotubes do not respond strongly to the type of nonpolar molecules found in the human breath.

Using 10 different organic coatings, the investigators created field-effect transistors comprising random networks of each of the different coated nanotubes, and the resulting array produces a characteristic change in

electrical output when exposed to volatile nonpolar organic substances. A computational technique known as principal component analysis can decipher the complex signal change produced when mixtures of nonpolar organic molecules pass over the sensor network. When plotted in two dimensions, the data from a simulated set of “healthy” and “lung cancer” patients form two clear clusters that readily distinguish the two sets of patients. The investigators also showed that their device could identify healthy rats from those with chronic kidney failure.

Rather than designing their own device, Dr. Dragonieri’s group used a Cyranose 320 built by Smiths Detection based in Pasadena, California. This hand-held electronic nose, which is used widely throughout the chemical and food processing industries, employs a nanocomposite sensor array to rapidly detect volatile organic compounds in the air.

In this study, Dr. Dragonieri’s team collected breath samples from 10 patients with NSCLC, 10 with COPD, and 10 healthy controls. After drying the samples, the investigators analyzed them using the Cyranose 320 and its onboard statistical software. Smellprints, analogous to fingerprints, from the three groups of patients were clearly distinguishable, with no ambiguity among the three groups. The investigators note that these results warrant conducting a large-scale, prospective clinical trial to determine whether this system could be useful in real clinical settings, including physician offices.

The results of Dr. Haick’s team’s work appear in the paper “Detection of nonpolar molecules by means of carrier scattering in random networks of carbon nanotubes: Toward diagnosis of diseases via breath samples.” An abstract of this paper is available at the journal’s Web site.

Dr. Dragnieri and his colleagues published their work in the paper “An electronic nose in the discrimination of patients with non-small cell cancer and COPD.” Investigators from the Leiden University Medical

Center and the University of Amsterdam in The Netherlands, as well as from the Fondazione Salvatore Maugeri in Cassano delle Murge, Italy, contributed to this work. An abstract of this paper is available at the journal's Web site.

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