Research Highlights

[Vol. 14]
Nanomechanical sensors detect cancer from breath

23 Apr, 2014

An array of functionalised membrane-type surface stress sensors (MSS) distinguishes cancer patients from healthy people through a signature response to breath samples.
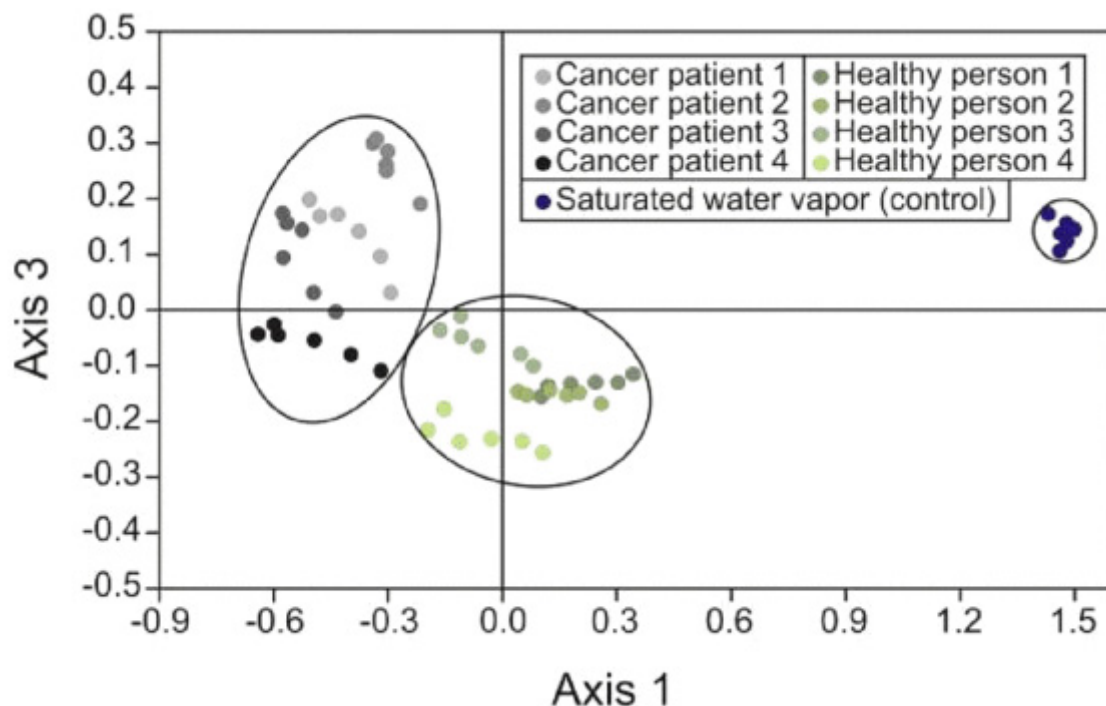

Figure : Principal Component Analysis case scores for breath samples of 4 healthy persons and 4 cancer patients. Each sample has been measured 6 times (colored dots). A breath sample bag containing saturated water vapor has been measured as a control (blue dots). Healthy persons can be clearly distinguished from cancer patients (the ellipses are a guide to the eye).

Cancer is the cause of 1 in 8 deaths worldwide, and early diagnosis can significantly improve survival rates. A collaboration of researchers in Switzerland and Japan has developed portable cancer detection units for non-invasive diagnosis. "We created an artificial nose that is sensitive enough to diagnose head and neck cancer through analysis of the breath," the researchers concluded in a recent report on their work.

The sensor design originates from conventional piezoresistive cantilever devices. Chemical layers coated on cantilevers absorb specific compounds and cause deflection of the cantilevers. These deflections can be measured through the change in electrical resistance at piezoresistors. However, these piezoresistive cantilever-type sensors have suffered from limited sensitivity. Recently, comprehensive structural optimization has led to a membrane-type surface stress sensor (MSS), achieving a significant improvement in sensitivity and stability. The MSS is composed of a thin

silicon membrane (typically 2.5 μm thick and 500 μm in diameter) suspended by four piezoresistive beams attached to the circumference.

Frederic Loizeau at the Ecole Polytechnique Fédérale de Lausanne, Hans Peter Lang at the University of Basel in Switzerland, Genki Yoshikawa at the National Institute of Materials Science in Japan and their colleagues fabricated an array of MSS and coated them with different polymers to absorb various chemical compounds in breath samples. Reporting at the 26th IEEE International Conference on Micro Electro Mechanical Systems (IEEE MEMS 2013), the researchers presented that MSS could distinguish, in a double blind trial, the breath of four cancer patients from four healthy people.

Reference

"Piezoresistive membrane-type surface stress sensor arranged in arrays for cancer diagnosis through breath analysis"
Frédéric Loizeau, Hans Peter Lang, Terunobu Akiyama, Sebastian Gautsch, Peter Vettiger, Andreas Tonin, Genki Yoshikawa, Christoph Gerber, and Nico de Rooij
Journal : 2013 IEEE 26th International Conference on Micro Electro Mechanical Systems (MEMS)
DOI : 10.1109/MEMSYS.2013.6474318

Affiliations

International Center for Materials Nanoarchitectonics (WPI-MANA), National Institute for Materials Science (NIMS), Namiki 1-1, Tsukuba, Ibaraki 305-0044, Japan

Contact information

International Center for Materials Nanoarchitectonics(WPI-MANA)

National Institute for Materials Science
1-1 Namiki, Tsukuba, Ibaraki 305-0044 Japan
Phone: +81-29-860-4710
E-mail: mana-pr[AT]ml.nims.go.jp