A versatile high-sensitivity surface stress membrane sensor

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(PhysOrg.com) -- An international team of researchers have developed a versatile and high-sensitivity sensor for detecting analytes ranging from gaseous to biological molecules.

National Institute for Materials Science (NIMS) announced on February 8, 2011 that Researcher Genki Yoshikawa of NIMS International Center for Materials Nanoarchitechtonics (MANA), Swiss Federal Institute of Technology, Lausanne and Nobel Laureate Dr. Heinrich Rohrer jointly developed a versatile high-sensitivity surface stress membrane sensor. Details were presented in Nano Letters of American Chemical Society.

The nanomechanical cantilever sensor is a promising device for real-time and label-free detection of various analytes ranging from gaseous to biological molecules. The major sensing principle is based on the analyte-induced surface stress, which makes a cantilever bend. Bending is detected by a reflected laser beam. However, this method is not applicable to an opaque analyte such as blood. Piezoresistive cantilevers applicable to opaque analytes have the problem of lower sensitivity.

In this work, an "adsorbate membrane" is suspended by four piezoresistive "sensing beams", which constitute a full Wheatstone bridge. Stress unbalance induced by the adsorbed analyte is efficiently detected by the bridge. Evaluation of this membrane-type surface stress sensor demonstrates a high sensitivity comparable to optical methods and a factor of more than 20 higher than that obtained with a standard piezoresistive cantilever. The finite element analyses indicate that the

sensitivity will be improved by changing dimensions of the membrane and beams.

Researchers suggest that this platform is expected to open a new era of surface stress-based sensing because of the various conveniences and advantages of the integrated piezoresistive read-out.

More information: Genki Yoshikawa, Terunobu Akiyama, Sebastian Gautsch, Peter Vettiger, and Heinrich Rohrer, "Nanomechanical Membrane-type Surface Stress Sensor", *Nano Letters*, Article ASAP, DOI:10.1021/nl103901a , Publication Date (Web): February 11, 2011.