

Source: Okayama University (JAPAN), Public Relations Division

For immediate release: 29 April 2019

Okayama University research: Technology to rapidly detect cancer markers for cancer diagnosis

(Okayama, 29 April) **Researchers at Okayama University report in the journal *Sensors and Actuators B: Chemical* that terahertz radiation can be used to rapidly detect makers for breast-cancer cells. The scientists present a technique that makes use of the binding properties of aptamers, synthetic organic molecules acting as probes for cancer cells.**

Breast cancer is the most common cancer in women. Detecting it in time is crucial for treatment to be successful. X-ray screening (mammography) is the standard detection technique but is not without risk as it involves exposure of a patient to ionizing radiation. Another approach for detecting breast cancer cells is based on terahertz (THz) radiation, which is sensitive to polar molecules like water — normal and cancer tissues do not have the same water content. Associate Professor Toshihiko Kiwa (Okayama University, Japan) and Professor Tsuneyuki Ozaki (INRS : Institut national de la recherche scientifique, Canada) and colleagues have now discovered a way to increase the sensitivity of THz radiation for the detection of makers of breast cancer cells, implying that ‘THz chemical microscopy’ could become a powerful alternative screening technique.

The key principle underlying the method of Associate Professor Kiwa and colleagues is that cancer and normal breast cells bind and don’t bind, respectively, to certain molecules known as aptamers. The aptamers consist of (single-stranded) DNA or RNA fragments; they have a high affinity for particular molecules — in the experiments of the team of Associate Professor Kiwa, these molecules were breast cancer cells.

The experimental setup of the researchers involved a sensing plate, consisting of a sapphire substrate, and silicon and silicon dioxide thin films. The aptamers were fixed to the top layer. Irradiating the plate with a specific laser creates charge carriers, the motion of which generates electromagnetic radiation in the THz range. The precise THz response depends, however, on whether the aptamers are ‘freestanding’ (no cells attached) or not (breast-cancer cells attached). The former corresponds to the situation where the sample on the sensing plate only consists of normal cells; for the latter, the sample contains breast-cancer cells.

The scientists noted that the detection method is highly sensitive: the so-called ‘limit of detection’ was found to be as low as 1 cancer cell in 0.1 milliliter of sample. Moreover, a qualitative assessment of a sample seems possible, as the change in THz signal can be associated with the number of cancer cells per aptamer. Although further investigation on the latter association is needed, Associate Professor Kiwa and colleagues conclude that “...

the results obtained from this study can be the spark of new evolution in the detection of breast cancer.”

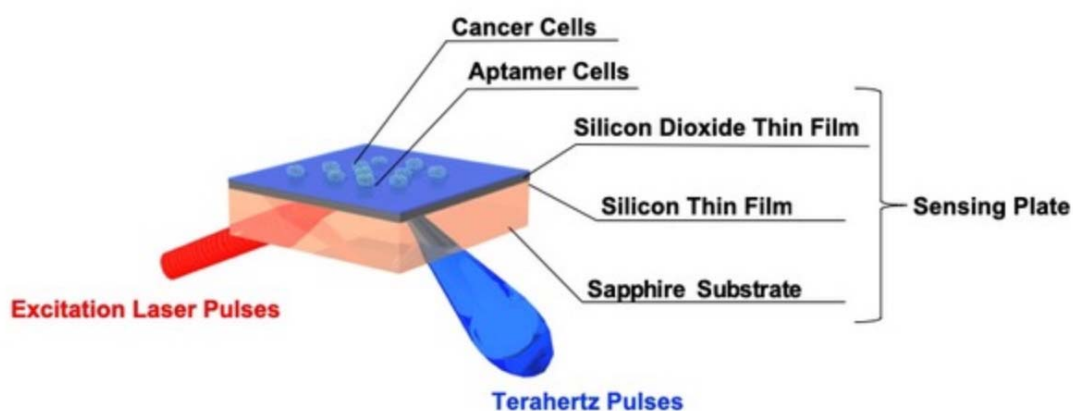
Background

Mammography

Mammography is the procedure in which low-energy X-rays are used to screen the human breast for cancer. Although it is the standard technique for breast cancer detection, the use of X-rays implies exposure to ionizing radiation. Because there have also been cases of false positives (apparent detection of breast cancer in a healthy patient) and false negatives (missed detections), alternative detection methods are desired. Associate Professor Toshihiko Kiwa and Professor Tsuneyuki Ozaki and colleagues have now reported a promising detection technique, in which a tissue sample is investigated by terahertz (THz) radiation.

Aptamers

Aptamers are short DNA or RNA molecules, or molecules built from peptides, that can bind to specific molecules. Associate Professor Kiwa and colleagues used the binding properties of two aptamers, mammaglobin B1 (MAMB1) and mammaglobin A2 (MAMA2). These aptamers bind to proteins (mammaglobin B and mammaglobin A, respectively) that are overexpressed in typical breast-cancer cells. Attached to a special engineered sensing plate, freestanding and bound (to cancer cells) aptamers have a different response to terahertz radiation. This difference can be used to distinguish a tissue sample with breast-cancer cells from a sample with only normal cells.



Caption

Breast-cancer cells bound to aptamers have a different terahertz response than freestanding aptamers. This notion can be exploited to detect, with high sensitivity, breast-cancer cells.

Reference

Eman M. Hassan, Ahmed Mohamed, Maria C. DeRos, William G. Willmore, Yuki Hanaoka, Toshihiko Kiwa, Tsuneyuki Ozaki. High-sensitivity detection of metastatic breast cancer cells via terahertz chemical microscopy using aptamers. *Sensors & Actuators: B. Chemical*, 287 (2019), 595–601.

DOI : <https://doi.org/10.1016/j.snb.2019.02.019>

Reference (Okayama Univ. e-Bulletin): Associate Professor Kiwa's team

e-Bulletin Vol.4 : [Unique terahertz chemical microscope for mapping chemical reactions](#)

e-Bulletin Vol.10 : [Simple, compact, highly sensitive SQUID based magnetic field measurement system to detection of a very small magnetic signals](#)

e-Bulletin Vol.11 : [High-performance Terahertz Project kick-off symposium](#)

e-Bulletin Vol.13 : [Terahertz chemical microscope: Innovative terahertz technology for high resolution mapping of chemical reactions, label free immunoassays, cosmetics research, and more](#)

OU-MRU Vol.54 (2018) : [Measuring ion concentration in solutions for clinical and environmental research](#)

News

- [High-Performance Terahertz Project Kick-off Symposium \(January 08, 2015\)](#)
- [Student Exchange Agreement Concluded with Canada's INRS \(October 18, 2016\)](#)

Correspondence to

Associate Professor Toshihiko Kiwa, Ph.D.

Advanced Electro Measurement Technology Laboratory,
Graduate School of Interdisciplinary Science and Engineering
in Health Systems, Okayama University,

3-1-1 Tsushimanaka, Kita-Ku, Okayama 700-8530, Japan

kiwa@okayama-u.ac.jp

<http://www.ec.okayama-u.ac.jp/~sense/index.html>



Associate Professor Toshihiko Kiwa

Further information

Okayama University

1-1-1 Tsushima-naka, Kita-ku, Okayama 700-8530, Japan

Public Relations Division

E-mail: www-adm@adm.okayama-u.ac.jp

Website: http://www.okayama-u.ac.jp/index_e.html

Okayama Univ. e-Bulletin: <http://www.okayama-u.ac.jp/user/kouhou/ebulletin/>

About Okayama University (YouTube):

<https://www.youtube.com/watch?v=iDL1coqPRYI>

Okayama University Image Movie (YouTube):

<https://www.youtube.com/watch?v=KU3hOIXS5kk>



OKAYAMA
UNIVERSITY



Okayama University supports the Sustainable Development Goals

Okayama University Medical Research Updates (OU-MRU)

The whole volume : [OU-MRU \(1-\)](#)

Vol.1 : [Innovative non-invasive 'liquid biopsy' method to capture circulating tumor cells from blood samples for genetic testing](#)

Vol.2 : [Ensuring a cool recovery from cardiac arrest](#)

Vol.3 : [Organ regeneration research leaps forward](#)

Vol.4 : [Cardiac mechanosensitive integrator](#)

Vol.5 : [Cell injections get to the heart of congenital defects](#)

Vol.6 : [Fourth key molecule identified in bone development](#)

Vol.7 : [Anticancer virus solution provides an alternative to surgery](#)

Vol.8 : [Light-responsive dye stimulates sight in genetically blind patients](#)

Vol.9 : [Diabetes drug helps towards immunity against cancer](#)

Vol.10 : [Enzyme-inhibitors treat drug-resistant epilepsy](#)

Vol.11 : [Compound-protein combination shows promise for arthritis treatment](#)

Vol.12 : [Molecular features of the circadian clock system in fruit flies](#)

Vol.13 : [Peptide directs artificial tissue growth](#)

Vol.14 : [Simplified boron compound may treat brain tumours](#)

Vol.15 : [Metamaterial absorbers for infrared inspection technologies](#)

Vol.16 : [Epigenetics research traces how crickets restore lost limbs](#)

Vol.17 : [Cell research shows pathway for suppressing hepatitis B virus](#)

Vol.18 : [Therapeutic protein targets liver disease](#)

Vol.19 : [Study links signalling protein to osteoarthritis](#)

Vol.20 : [Lack of enzyme promotes fatty liver disease in thin patients](#)

Vol.21 : [Combined gene transduction and light therapy targets gastric cancer](#)

Vol.22 : [Medical supportive device for hemodialysis catheter puncture](#)

Vol.23 : [Development of low cost oral inactivated vaccines for dysentery](#)

Vol.24 : [Sticky molecules to tackle obesity and diabetes](#)

Vol.25 : [Self-administered aroma foot massage may reduce symptoms of anxiety](#)

Vol.26 : [Protein for preventing heart failure](#)

Vol.27 : [Keeping cells in shape to fight sepsis](#)

Vol.28 : [Viral-based therapy for bone cancer](#)

Vol.29 : [Photoreactive compound allows protein synthesis control with light](#)

Vol.30 : [Cancer stem cells' role in tumor growth revealed](#)

Vol.31 : [Prevention of RNA virus replication](#)

Vol.32 : [Enzyme target for slowing bladder cancer invasion](#)

Vol.33 : [Attacking tumors from the inside](#)

Vol.34 : [Novel mouse model for studying pancreatic cancer](#)

Vol.35 : [Potential cause of Lafora disease revealed](#)

Vol.36 : [Overloading of protein localization triggers cellular defects](#)

Vol.37 : [Protein dosage compensation mechanism unravelled](#)

Vol.38 : [Bioengineered tooth restoration in a large mammal](#)

Vol.39 : [Successful test of retinal prosthesis implanted in rats](#)

Vol.40 : [Antibodies prolong seizure latency in epileptic mice](#)

Vol.41 : [Inorganic biomaterials for soft-tissue adhesion](#)

- Vol.42 : [Potential drug for treating chronic pain with few side effects](#)
- Vol.43 : [Potential origin of cancer-associated cells revealed](#)
- Vol.44 : [Protection from plant extracts](#)
- Vol.45 : [Link between biological-clock disturbance and brain dysfunction uncovered](#)
- Vol.46 : [New method for suppressing lung cancer oncogene](#)
- Vol.47 : [Candidate genes for eye misalignment identified](#)
- Vol.48 : [Nanotechnology-based approach to cancer virotherapy](#)
- Vol.49 : [Cell membrane as material for bone formation](#)
- Vol.50 : [Iron removal as a potential cancer therapy](#)
- Vol.51 : [Potential of 3D nanoenvironments for experimental cancer](#)
- Vol.52 : [A protein found on the surface of cells plays an integral role in tumor growth and sustenance](#)
- Vol.53 : [Successful implantation and testing of retinal prosthesis in monkey eyes with retinal degeneration](#)
- Vol.54 : [Measuring ion concentration in solutions for clinical and environmental research](#)
- Vol.55 : [Diabetic kidney disease: new biomarkers improve the prediction of the renal prognosis](#)
- Vol.56 : [New device for assisting accurate hemodialysis catheter placement](#)
- Vol.57 : [Possible link between excess chewing muscle activity and dental disease](#)
- Vol.58 : [Insights into mechanisms governing the resistance to the anti-cancer medication cetuximab](#)
- Vol.59 : [Role of commensal flora in periodontal immune response investigated](#)
- Vol.60 : [Role of commensal microbiota in bone remodeling](#)
- Vol.61 : [Mechanical stress affects normal bone development](#)
- Vol.62 : [3D tissue model offers insights into treating pancreatic cancer](#)
- Vol.63 : [Promising biomarker for vascular disease relapse revealed](#)
- Vol.64 : [Inflammation in the brain enhances the side-effects of hypnotic medication](#)
- Vol.65 : [Game changer: How do bacteria play Tag?](#)
- Vol.66 : [Is too much protein a bad thing?](#)



「Pergola」 Kazuyo Sejima + Ryue Nishizawa / SANAA
Okayama University (Tsushima Campus, Okayama City)

http://www.okayama-u.ac.jp/eng/access_maps/Tsushima_Campus.html

◆About Okayama University

Okayama University is one of the largest comprehensive universities in Japan with roots going back to the Medical Training Place sponsored by the Lord of Okayama and established in 1870. Now with 1,300 faculty and 13,000 students, the University offers courses in specialties ranging from medicine and pharmacy to humanities and physical sciences.

Okayama University is located in the heart of Japan approximately 3 hours west of Tokyo by Shinkansen.

Website: http://www.okayama-u.ac.jp/index_e.html



Japan (日本)



Hirofumi Makino, M.D., Ph.D.
President, Okayama University

“Okayama University supports the Sustainable Development Goals”



OKAYAMA UNIVERSITY
×
SDGs

