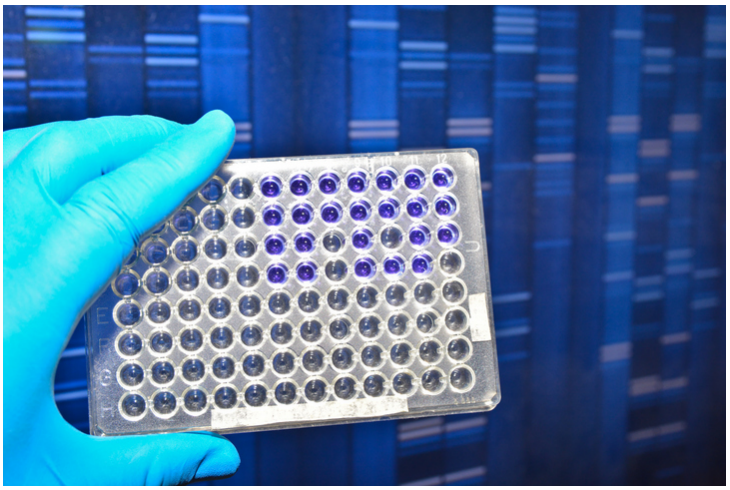
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Metamaterial Sensor Platforms for Terahertz DNA Sensing

TECHNOLOGY NUMBER: 6246



OVERVIEW

High-sensitivity metamaterial Terahertz DNA sensors based on resonance

- Enables label-free detection and differentiation of DNA molecules
- Genetic diagnostics, biomedical analysis, forensic science

BACKGROUND

Over the past few decades, Terahertz (THz) sensing has garnered significant attention due to its ability to distinguish materials based on unique spectral signatures. Conventional DNA sensing methods often rely on tagging DNA molecules with agents like fluorescent markers, which can interfere with the results and require additional preparation steps. These traditional approaches also face challenges such as limited sensitivity and the necessity of substantial sample amounts. Prior advancements in THz sensing have focused on resonance-based narrowband biosensing and integrated microstrip line resonators for detecting refractive index changes in DNA. More recently, split ring resonators on various substrates have been explored to enhance sensitivity and minimize sample quantities required. Despite these advancements, there remains a need for more precise, efficient, and less obtrusive DNA differentiation technologies that can overcome these existing limitations.

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Category

Hardware
Engineering & Physical Sciences
Semiconductor, MEMS, and Electronics

Inventor

Kyungjun Song
Mahdi Aghadjani
Nan Zheng
Pinaki Mazumder

Further information

Joohee Kim
jooheek@umich.edu

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INNOVATION

Researchers at the University of Michigan have developed three high-sensitivity metamaterial Terahertz DNA sensors designed to differentiate DNA molecules based on their refractive indices. These sensors employ subwavelength scatterers to produce higher-order responses, significantly enhancing sensitivity. The proposed designs include patch-wire, loop-wire, and symmetrical loop structures, each analyzed through both numerical electromagnetic methods and physical circuit models. This approach yields highly refined pass-bands, crucial for precise DNA differentiation. The new sensors can distinguish between DNA molecules without the need for labeling, thus eliminating unwanted interferences and simplifying the preparation process. Real-world applications of this technology are diverse, spanning genetic diagnostics, forensic science, and other biomedical fields where accurate DNA analysis is essential. The increased sensitivity and reduced sample requirements position this innovation as a significant advancement over traditional DNA sensing methods.

ADDITIONAL INFORMATION

REFERENCES

N. Zheng, M. Aghadjani, K. Song and P. Mazumder, "Metamaterial sensor platforms for Terahertz DNA sensing," 2013 13th IEEE International Conference on Nanotechnology (IEEE-NANO 2013), Beijing, China, 2013, pp. 315-320, doi: 10.1109/NANO.2013.6720831

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US9551655 "Metamaterial sensor platforms for terahertz DNA sensing"