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Terahertz Microfluidics Enables Label-Free Detection

By generating terahertz waves in close proximity to a microfluidic channel, researchers in Japan have developed a device which could be used to detect cancer, diabetes and the flu.

AsianScientist (Feb. 23, 2018) – In a study published in *APL Photonics*, researchers at Osaka University, Japan, have developed a diagnostic lab-on-a-chip which combines terahertz (THz) waves with a microfluidic device. Their invention could be used for the early detection of diseases.

The use of THz waves for biosensing has received considerable attention in recent years for their ability to detect molecular vibrations and rotations without using labels that may interfere with the properties of the substances of interest. However, until now, the diffraction limit of THz waves and their strong absorption by water have limited the widespread use of this technique.

In the present study, a team of scientists led by Professor Masayoshi Tonouchi used THz waves within a microfluidic device to detect the composition of fluids. Their invention, which they call a nonlinear optical crystal (NLOC) chip, is able to locally generate THz radiation in close proximity to the single microchannel device, improving efficiency. The sensor chip was used to analyze mineral concentrations by comparing frequency shifts resulting from the presence of ions.

> "Using our technique, we have been able to detect solution concentrations of several femtomoles in volumes of less than a nanoliter," said Tonouchi. "Such high-sensitivity detection, without the need for labelling moieties, has great potential for low-invasive clinical techniques in the future."

Early and rapid detection of a number of common diseases such as cancer, diabetes and influenza is expected to be one of the major applications of the technique. Only very small volumes of bodily fluid would need to be collected from patients, thus reducing the pain and discomfort of numerous exploratory procedures. In addition, the technique allows living cells to be analyzed in a non-destructive way, which has numerous potential benefits in research.

> "Achieving high sensitivity without the need for a high-power optical or THz source, near-field probes or prisms, opens up a number of possibilities," said lead author Dr. Kazunori Serita. "We are very excited about the potential of our findings to lead to rapid detection and compact device design. In particular, we see our results accelerating the development of THz lab-on-a-chip devices."

The article can be found at: Serita et al. (2018) Terahertz Microfluidic Chips Sensitivity-enhanced with a Few Arrays of Meta-atoms.

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