On-chip absorption spectrometer – Spectroscopy with tunable wavelength with minimal space requirement

TLB
Technologie-Lizenz-Büro
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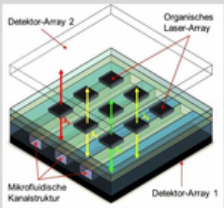
This on-chip optofluidic array with organic lasers is ideal for rapid on-site investigation of any analyte that absorbs (itself or its products of a specific detection reaction) in the visible (and near IR) spectrum.
In combination with a previously developed lamination process (see 17/052TLB), it will be possible to offer an extremely compact, robust, simple and cost-effective on-site analytic system. Besides medicine, application areas such as food analysis or environmental analysis can also benefit.

- Universal and robust base unit
- Disposable cartridges for specific analytes
- For any wavelength in the visible and NIR (400 to 800 nm)
- Multiple wavelengths per channel and analyte possible
- Tuning of wavelengths during operation possible
- Simple and cost-effective production
- No filters or beam splitters necessary (space saving design)



Application

Optofluidic on-chip absorption spectroscopy has a wide range of applications, such as product monitoring in the chemical industry, pollutant detection in environmental analysis, or blood analysis in medicine. Rapid on-site food inspection or monitoring of important parameters during production can easily be performed.
In medicine, such systems offer efficient opportunities for point-of-care diagnostics, such as blood analyses without waiting times that can be compared 1:1 with the laboratory results.

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Background

When using spectrometers, it is essential to know the light intensity entering and leaving the substance under examination in order to precisely determine the absorbed light. Beam splitters are generally used for this purpose, which split off a fraction of the light beam for a reference measurement.

Problem

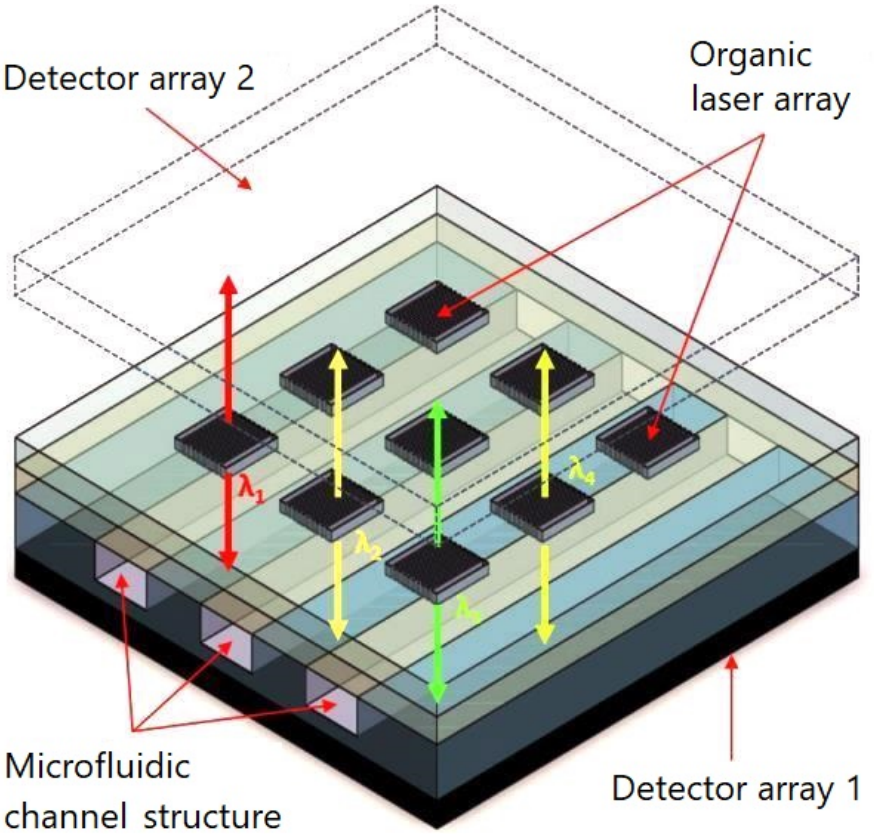
By using filters and beam splitters, conventional spectrometers are comparatively large and of complex design.

Solution

The invention presented here uses organic lasers in combination with microfluidic channels directly on-chip to realize an elegant solution for a spectrometer without beam splitter and beam guidance. The resulting reduction in the number of components used makes the spectrometer robust and much easier to handle than conventional devices.

The figure below shows an array of nine organic lasers (DFB lasers), each emitting light at a specific wavelength. A liquid flowing through the underlying microchannels can be examined for its absorption behavior with respect to each of the wavelengths used. The second beam direction of the lasers serves as a reference signal.

The analysis system can be implemented cost-effectively for any wavelength of visible light as well as in the near infrared (NIR) – with a spectral width of only 1 nm. Moreover, the materials used to make organic DFB lasers and other structures are non-toxic and can therefore be disposed of without any restrictions.



CAD-Model of an optofluidic analytic chip [Figure: Karlsruhe University of Applied Sciences].

Find out more

Sebastian Morain, Jörg Knyrim, Martin Reufer, Christian Karnutsch: "Optically Pumped Organic Lasers for Microfluidic On-Chip Absorption Spectroscopy", IEEE WORKSHOP| June, 8th -9th 2017, Mülheim an der Ruhr, https://repositorium.hs-ruhrwest.de/frontdoor/deliver/index/docId/34/file/Abstractbook_Online_Version_2017_06_12.pdf#page=16