HORIZON 2020

Large scale micro-and nanofabrication technologies for bioanalytical devices based on R2R imprinting

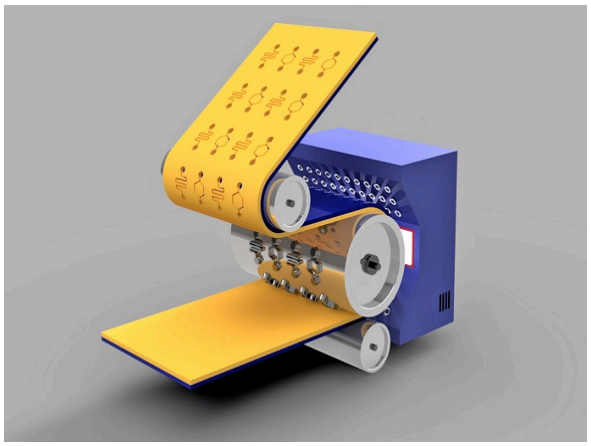
Results in Brief

Using roll-to-roll processing to manufacture microfluidics for lab-on-a-chip devices

By reducing the costs of roll-to-roll technologies, researchers with the EU-funded R2R Biofluidics project have opened the door to using R2R to develop novel diagnostics for rapid and reliable pathogen detection.

INDUSTRIAL TECHNOLOGIES

FUNDAMENTAL RESEARCH



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Roll-to-Roll (R2R) processing is the method of applying coatings, printing or performing other techniques, starting with a roll of flexible material and then re-reeling after the process, to create an output roll. Once coated, laminated or printed, the rolls of material can be slit to their finished size.

Unlike batch processing, R2R is a continuous process that can lead to agile manufacturing and increased automation – not to mention a 10x reduction in cost. Therefore, the process has long been used by the graphic printing industry and is today attracting the attention of a number of other sectors. For example, the electronics sector uses R2R to create devices such as organic light emitting diodes on a roll of flexible plastic or metal foil.

Now, the EU-funded R2R Biofluidics (Large scale micro-and nanofabrication

technologies for bioanalytical devices based on R2R imprinting) project is working to adapt the R2R process for the diagnostic and bioanalysis industries, predominantly for manufacturing microfluidics for lab-on-a-chip devices. “We need high quantities of these products, which will be used for diagnostics, drug discovery and food control,” says project coordinator Martin Smolka. “R2R technologies allow for the significant reduction in production costs required to achieve mass production.”

Microfluidics deals with the behaviour, precise control and manipulation of fluids that are geometrically constrained to a small, typically sub-millimetre scale. Lab-on-a-chip (LOC) devices are miniaturised devices used to carry out laboratory experiments on a very small scale. LOCs can integrate several laboratory functions on a chip ranging in size from a few millimetres to a few square centimetres – thus allowing for high-throughput screening and automation.

A quantum leap

R2R Biofluidics has demonstrated a completely new process chain for the large-scale production of LOC devices for such point-of-care applications as detecting antibiotic-resistant pathogens. Using an in vitro diagnostic chip with imprinted microfluidic channels based on detecting chemiluminescence and containing imprinted optical nanostructures for light coupling, researchers were able to improve the device’s performance. Chemiluminescence is the emission of light during a chemical reaction that produces significant quantities of light.

“These novel chips designed for chemiluminescence detection provide improved sensitivity, thanks to their imprinted optical structures,” explains Smolka. “R2R fabrication will allow for the high throughput, low-cost manufacturing of these innovative devices, facilitating their market entrance.”

Researchers also demonstrated how to develop cell chips containing imprinted cavities and micro- to nano-scale channels for controlled neuron culturing, which can be applied in high-throughput drug screening. Using this demonstrator as a foundation, SCIENION, one of the project’s partners, developed a customised roll-to-roll microarray spotter for biomolecule printing.

“Introducing R2R technologies for high-throughput manufacturing for diagnostic tests represents a quantum leap,” says SCIENION AG CEO Holger Eickhoff. “By offering such low cost flexible devices, this technology will soon be heading towards an unrivalled level of diagnostic device production.”

Award winning idea

In September 2018, R2R Biofluidics received the Austrian Fast Forward Award in recognition of its pioneering work to develop novel diagnostics for rapid and reliable

pathogen detection. “This award recognises our position as pioneers in such R2R-based process steps as implementing new imprinting concepts and achieving the very first spotting of biomolecules using R2R technology,” adds Smolka.

Keywords

R2R Biofluidics | R2R processing | roll-to-roll technology | diagnostic | bioanalysis | microfluidics | lab-on-a-chip

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