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ARTIC

Nature-inspired micro-fluidic manipulation using artificial cilia

Specific Targeted Research Project

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Press Information

January 14, 2011

Novel micro fluid-propulsion technology, inspired by nature, developed by European ARTIC project
New and effective fluid propulsion technology inspired by ciliates opens new possibilities for lab-on-chip devices for medical diagnosis

Eindhoven, the Netherlands - Leading European research groups and high-tech companies in the areas of micro-fluidics (the precise manipulation of minute quantities of fluid) and materials science, joining forces in the ARTIC project four years ago, have developed a revolutionary new fluid propulsion technology for use in lab-on-chip devices

Inspired by microorganisms known as ciliates that use oscillating hair-like structures (cilia) to swim through water (hence the project name ARTIC = ARTIficial Cilia), this new fluid propulsion technology is designed to operate on the internal surfaces of micro-channels. These channels, which have roughly the same diameter as a human hair, are an integral part of lab-on-chip devices for the analysis of body fluids such as blood, urine or saliva. By incorporating magnetic particles into the polymeric artificial cilia placed on the channel walls, they can be actuated using time-dependent magnetic fields. This new technology turned out to be very effective: the fluid flow generated in the micro-channels is at least comparable to other micro-fluidic principles such as electro-osmosis, but has the advantages of simple actuation and compatibility with bio-fluids; next to pumping, the artificial cilia can also be used for fluid mixing. Altogether, the technology enables the active control of microscopic quantities of fluid in lab-on-chip biosensor applications, thereby creating the opportunity to conduct fast and efficient complex analyses, such as DNA profiling or pathogen identification, at a patient's bedside or in a doctor's surgery.

"The project has been very successful in developing this beautiful technology, achieving the goals we envisioned at the start by fruitful and pleasant collaborations between the complementary partners; the technology can now be exploited for new approaches to lab-on-chip devices" says Jaap den Toonder, ARTIC project leader and Chief Technologist at Philips Corporate Technologies.

Jürgen Rühe, professor at the University of Freiburg adds, "Nature has worked on the transport and mixing of liquids and the analysis of extremely complex mixtures of bio-chemical substances for more than a billion years, which made it a great source of inspiration for the development of materials as well as for the design of complex systems. Learning from nature allowed us to successfully develop and prove new concepts for high-tech healthcare applications".

The ARTIC project members comprise (in alphabetic order):
- Delft University of Technology (The Netherlands) – fluid flow characterization
- Eindhoven University of Technology (The Netherlands) – fluid flow and fluid-structure interaction modeling
- Liquids Research Ltd (United Kingdom) – polymerisable ferrofluids and magnetic bead synthesis
- Philips – project leadership, MEMS (Micro Electro-Mechanical Systems) technology, micro-channel device manufacturing, and system integration
- Polytechnic University of Bucharest (Romania) – magnetic modeling and design
- University of Bath (United Kingdom) – biomimetics (the application of mechanisms found in nature to engineering problems)
- University of Freiburg – IMTEK (Germany) – synthesis of tailor-made materials and microstructuring of artificial cilia
- University of Groningen (The Netherlands) – mechanical and fluid flow modeling

The European ARTIC project ran from December 1, 2006 to November 30, 2010, and was partly funded under the European Sixth Framework NMP Programme and partly by the project members. The results were published in over 30 scientific publications.

More information on the ARTIC project can be found at:
http://www.hitech-projects.com/euprojects/artic/

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