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Georgios Kokkinis

TU Wien, Austria

Magnetic nanoparticles and sensors for biomedical applications

Lab-on-a-chip systems that translate the presence of biological entities (e.g., biomolecules, cells and pathogens) into an electronic signal are on a rise. Scientific research, driven by the promise for miniaturization has successfully shifted several analytical and diagnostic methods to the submillimeter scale. The miniaturization process was made possible with the birth of microfluidics. The analysis is performed within the chip. The use of magnetic markers (magnetic particles – MPs – functionalized with ligands) in combination with the application of magnetic fields has also been steadily gaining interest. Magnetic fields can be well tuned and applied from integrated microconductors. MPs can be manipulated inside microfluidic channels by those fields and can be detected by integrated microsensors, makes this technology an ideal candidate for lab-on-a-chip applications. In our approach the biomolecules to be quantified are conjugated with functionalized magnetic markers (magnetic nanoparticles – MNPs), are in suspension and are introduced in the measurement channel (abbreviation: BMNPs – biomolecule MNPs). Bare MNPs (not functionalized) in suspension are simultaneously introduced in the reference channel. There is no flow thus the liquids inside the channels are static. Current carrying microconductors (MCs), fabricated underneath the channels, impose a magnetic field gradient to the MNPs and BMNPs and move them from the inlet to the outlet of the channels. Underneath the first (inlet) and the last (outlet) microconductors of each channel, giant magnetoresistive - GMR, spin valve microsensors are fabricated. The time the particles need to accumulate on the sensor's surface and the magnitude of the sensor's output determines their concentration.

Biography

Georgios Kokkinis has completed his PhD in 2016 from the Technical University of Vienna, Institute of Sensors and Actuators Systems, where he is currently a Post-Doctoral Fellow. His research focuses in combining microfluidics, magnetic sensors and nanoparticles in sensing applications. In parallel, he is employed by Pessl Instruments GmbH as a microfluidics expert for the development of a chip electrophoresis ion sensing platform.

georgios.kokkinis@tuwien.ac.at

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