From Smartphones to Diagnostics: programmable droplet microfluidics

By
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Host: Assoc Prof Lew Wen Siang

Abstract

Our group is developing integrated analytical systems for healthcare and medicine that utilize inexpensive electronics for sample detection and manipulation. Such systems will find applications as tools for life science and in new diagnostics for molecular and cellular analysis. This talk describes the development of a new generation of programmable miniature microfluidic systems, based on digital microfluidics. Unlike conventional microfluidic systems that require pumps and valves to control liquids, digital microfluidics (DMF) employs Electro Wetting on Dielectric (EWOD) to manipulate and process nanolitre droplets of liquid using electric fields. The chips contain thousands of electrodes, manufactured using active matrix Thin Film Transistor (TFT) technology; the same low cost electronics that are used in mobile phone displays. The devices are the size of microscope slides and contain thousands of individual electrodes, each of which can be programmed separately. Each electrode can be switched on and off independently allowing many droplets to be manipulated in parallel, providing an extremely flexible platform that enables the development of automated custom diagnostic assays. The DMF chips include sensors to measure droplet position and droplet volume, providing feedback control to automatically verify and validate successful operation. The systems support a wide range of different chemical and biochemical assays, for example immuno- assays and DNA analysis. Further examples of low-cost electronic systems for analyte and cell detection will be given, including microfluidic impedance cytometry for label free cell analysis and Si nano-wire biosensors made using simple fabrication methods.

Short Biography

Hywel Morgan is Professor of Bioelectronics at the University of Southampton. He is a Royal Society Industry Fellow with Sharp Labs Europe and is also Deputy Director of the University’s Institute for Life Sciences. His research focuses on the fusion of low cost electronic devices with microfluidic systems for next generation miniature diagnostic systems. He has published over 200 journal papers and co-authored a text-book on AC electrokinetics. He sits on the editorial board of Microfluidics and Nanofluidics, and Biomicrofluidics. In 2004 he was awarded the Desty memorial prize for innovation in separation science. He is a Fellow of the Institute of Physics and a Fellow of the Royal Society of Chemistry. He holds a Royal Society Wolfson research merit award.