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Preface to Special Topic: Selected Papers from the Second Conference on Advances in Microfluidics and Nanofluidics and Asia-Pacific International Symposium on Lab on Chip

Z. P. Wang and C. Yang

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Preface to Special Topic: Selected Papers from the Second Conference on Advances in Microfluidics and Nanofluidics and Asia-Pacific International Symposium on Lab on Chip

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The Second Conference on Advances in Microfluidics and Nanofluidics and Asian-Pacific International Symposium on Lab on Chip were held in Singapore on 5–7 January 2011. It was a successful conference providing a highly interactive forum that brought together approximately 200 researchers of different disciplines from more than 20 different countries and regions. This special issue is dedicated to the original contributions that were presented at the conference and covers a wide range of research directions from both fundamental and practical application of microfluidics and nanofluidics, including acoustofluidics\textsuperscript{1,2} and diagnosis,\textsuperscript{4} dielectrophoresis,\textsuperscript{5–7} droplet microfluidics,\textsuperscript{8–15} electrokinetic flow\textsuperscript{16,17} and electrophoresis,\textsuperscript{18} micro- and nanofabrications,\textsuperscript{19–21} as well as surface modification.\textsuperscript{22}

Beginning with acoustofluidics, Wang, Jalikop, and Hilgenfeldt\textsuperscript{1} reported a bubble microfluidic device to filter, enrich, and preconcentrate particles of selected sizes through oscillating microbubbles of radius 20–100 \(\mu\)m driven by ultrasound. A new technique for transporting micro-particles and cells using ultrasonic acoustophoresis between two miscible fluid streams was presented by Liu, Hartono, and Lim.\textsuperscript{2} Buchegger \textit{et al.}\textsuperscript{3} developed a multilaminar continuous flow mixer that enables the investigation of the dynamics of biochemical reactions up to 2.5 s reaction time with a resolution of 500 \(\mu\)s. Homsy \textit{et al.}\textsuperscript{4} presented a simple, low-cost, and hybrid plasma sample preparation microfluidic device. It was demonstrated that the device could extract reproducibly 12 \(\mu\)l of plasma from undiluted whole blood within 7 min.

On-chip trapping, characterization, and separation of two species of Cryptosporidium (\textit{C.parvum} and \textit{C.muris}) and Giardia Lambia (\textit{G.Lambia}) using dielectrophoresis (DEP) were presented by Unni \textit{et al.}\textsuperscript{5} Chaurey \textit{et al.}\textsuperscript{6} reported an electrokinetic framework for designing insulator constriction-based dielectrophoresis devices with enhanced ability to trap nanoscale biomolecules in physiological media of high conductivity, through coupling short-range dielectrophoresis forces with long-range electrothermal flow. Lewpiriyawong and Yang\textsuperscript{7} demonstrated the use of sidewall Ag-Polydimethylsiloxane (AgPDMS) composite electrodes in a PDMS microfluidic device to induce transverse DEP effect, which is capable of performing particle DEP characterization and continuous separation of submicron and micron particles.

By mechanically perturbing a stable water-in-water jet, Shum, Varnell, and Weitz\textsuperscript{8} demonstrated that water-in-water emulsions can be prepared in a controlled and reproducible fashion. Nguyen and Chen\textsuperscript{9} had investigated the effect of slippage on the thermocapillary migration of a small liquid droplet on a horizontal solid surface through theoretical and numerical methods, and found that the dynamic contact angles and the contact angle hysteresis of the droplet are strictly correlated to the slip coefficient. An optical detection technique using two-photon fluorescence lifetime imaging microscopy, with an aligning-summing and non-fitting division method, was reported by Jiang \textit{et al.}\textsuperscript{10} to depict two-dimensional maps of mixing dynamics by chaotic advection in microdroplets with high temporal and spatial resolution. Xu, Nguyen, and Wong\textsuperscript{11} presented a technique for temperature-induced merging of droplets in a microchannel, and they found that such merging is effective at high

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temperature and low total flowrate. In an integrated technology combining surface acoustic wave (SAW) and electro-wetting on dielectric (EWOD), presented by Li et al.,\textsuperscript{12} EWOD was used to guide and precisely position microdroplets which could then be actuated by SAW devices for particle concentration, acoustic streaming, mixing, and ejection, as well as for sensing.

Martel and Cross\textsuperscript{13} described electrowetting actuation of sub-μL droplets for the handling of an artificial membrane including its formation, displacement, and the separation of its leaflets. To enhance the mixing process in a droplet, Lee, Chen, and Lai\textsuperscript{14} studied the phenomena to drive the droplet at resonant frequencies and at alternating driving frequencies in a parallel-plate EWOD device. Liu, Ting, and Gong\textsuperscript{15} reported the results of using a controllable air venting element to manipulate liquid plugs in microchannel, including merging, mixing, and other operations.

To address the experimentally observed phenomenon of the direction dependent displacement time, Lim and Lam\textsuperscript{16} analyzed the displacement flow of two fluids with various concentration differences. Ng et al.\textsuperscript{17} presented a numerical model with faradaic reactions for investigating DC-biased AC-electrokinetic flow over symmetrical electrodes. A fully electrokinetic-driven microchip was reported by Lin, Wang, and Fu\textsuperscript{18} for rapid DNA digestion and time-resolved capillary electrophoresis analysis.

Several papers present the research results on fabrication techniques. Sridhar et al.\textsuperscript{19} reported the work on focused ion beam (FIB) milling of microchannels in lithium niobate and found that it was indeed easier than previously assumed to fabricate nanochannels with low aspect ratio directly on lithium niobate using the FIB milling technique. CO\textsubscript{2} laser was applied to induce glass strip peeling off to form microchannels on soda lime glass substrates, as reported by Wang and Zheng.\textsuperscript{20} Asthana et al.\textsuperscript{21} presented a nonlithographic embedded template method for rapid and cost-effective fabrication of a selectively permeable calcium-alginate (Ca-alginate) based microfluidic device with long serpentine delay channel. Finally, surface modification of cyclic olefin copolymer (COC) by 2-methacryloyloxyethyl phosphorylcholine monomer using photografting technique was reported by Jena and Yue,\textsuperscript{22} showing the resistance to both protein adsorption and cell adhesion in COC-based microfluidic devices.

The wide coverage of the articles in this special issue provides good insight into ongoing research in microfluidics and nanofluidics. It is our sincerest hope that the readers can be inspired to continue to advance microfluidics and nanofluidics in both fundamental and applied technology aspects.

We would like to thank Hsueh-Chia Chang, Leslie Yeo, as well as Linda Boniello and Janis Bennett from the American Institute of Physics for their friendly suggestions, guidance, and timely assistance in organizing the conference and in preparation of this special issue. Last but not least, we thank all the authors who have taken time to contribute papers for this special issue.

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