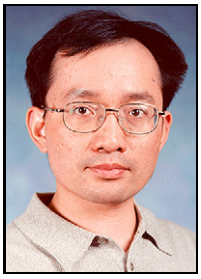
Transforming Microfluidics into Laboratory Automation



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The advent of microfluidic platforms equipped with novel nanomaterials and molecular processes within a biomedical context has been regarded as the transformative technology for a wide range of applications from clinical diagnostics and drug discovery to monitoring of therapeutic efficiency. The implementation of such technology into a format that is suitable for laboratory automation represents an essential step for translating fundamental research in microfluidics into reality in biomedicine. This issue of JALA is dedicated to highlighting emerging research areas in microfluidics and nanomaterials for driving a new paradigm in laboratory automation applications.

In the past decades, scientific communities have identified novel physical phenomena and innovative materials in the micro- and nanodomains. Integrating these microfluidic techniques and nanomaterials has provided great promise in performing biomedical analysis with a volumetric scale that is orders of magnitude below traditional practice, reducing the processing time and cost dramatically, and improving the sensitivity and specificity of the overall process. With the innovative toolbox developed, one of the challenges in the field is driven by the need to transform these technological modularities into laboratory automation applications. In particular, the sample preparation procedures required for handling biological samples, the sensor interface for fully automated processing, and system integration to truly realize lab-on-a-chip are some of the key challenges that require innovative solutions for laboratory automation applications.

The articles in this issue address some of the most critical challenges in miniaturization sciences for laboratory automation from the perspective of component development and system integration. In actuation component development, S. K. Cho et al. discuss a micropumping scheme based on the effect of cavitational microstreaming that leads to connection- and wiring-free pumping; R. Davalos et al. demonstrate sample concentration and enrichment using contactless dielectrophoresis; and D. J. Yao et al. implement a microfluidic parallel DNA ligation assay using core–shell droplets and their manipulation by electrowetting on dielectric. In biochemical sensing, D. Garcia et al. discuss the design and parametric strategy for electrochemical biosensing; N. Li reports an aptamer biosensor for detection of non-nucleic acid targets; J. Chae et al. presents an approach for protein detection based on the principle of physisorption; and M. Kim et al. summarize the developments of nanopore-based devices for bimolecular recognition and single-molecule analysis of molecular bindings. At the system level, A. Woolley et al. report

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that integration of multiple functions and component on a chip can overcome the problems of high detection limit and poor resolution power in biochemical analysis; J. Y. Yoon et al. demonstrate a lab-on-chip for field utilizations in detecting *Escherichia coli* and mouse immunoglobulin; and G. B. Lee et al. review the technical barriers and current advances in developing a microfluidic system.

We would like to thank all the authors who contributed to these insightful reports and the many referees who provided constructive reviews that helped enhance the quality of the reports. We owe a special debt of gratitude to the managing editor of JALA, Nan Hallock, for her effort to keep things on track and timing the publication of this issue that highlights several emerging technologies in miniaturization and laboratory automation.

Sincerely,

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