GUEST EDITORIAL

BioMEMS and Microfluidics

We are pleased to present this special section on BioMEMS and Microfluidics for SPIE's *Journal of Microlithography, Microfabrication, and Microsystems* (JM^3). This section showcases the recent developments in the exciting multidisciplinary fields of microfluidics and biomedical microelectromechanical systems (BioMEMS). Interest in miniaturized analytical systems, such as electrophoresis and high-throughput drug discovery instrumentation, strongly influenced early developments in microfluidics and BioMEMS research. Recent progress in MEMS technologies now permits fabrication of structures with feature sizes that range from millimeters to nanometers. Today, BioMEMS and microfluidics applications are quite diverse and are focused primarily in three areas: life sciences, point of care (POC) medicine, and environmental applications.

In the life sciences, recent research efforts have focused on bio/chemical analyses, pharmaceutical high-throughput systems, tissue and cell engineering, and biomaterial surface modification. Research efforts in POC medicine have been applied to proving diagnosis and treatment at the patient's bedside. Examples include miniaturized drug delivery systems and multianalyte sensors for blood chemistry analysis. Finally, in environmental applications, researchers have been focusing on developing inexpensive sensors for *in situ* monitoring of contaminants in the environment or measuring people's exposure to environmental contamination.

The majority of BioMEMS applications utilize liquid samples, which are often complex suspensions of macromolecules (e.g., DNA, proteins) or cells (e.g., blood). These samples typically must undergo sample preparation steps (e.g., cells lysed, DNA labeled) and then be dosed and transported to/from the analysis site. These sample preparation and positioning steps are achieved using microfluidics—an area that encompasses microscale fluid flows.

An important trend in BioMEMS and microfluidics that emerged recently is the move toward polymer-based devices and systems. Replication technologies such as plastic molding and nanoimprinting have received wide attention. One of the driving forces behind this trend is that researchers in the life sciences have always worked with polymers and glass. Another reason is that these technologies make it feasible to replicate BioMEMS and microfluidic devices at a substantially lower cost.

In this special section, we present a group of papers on the recent developments in microfluidics and BioMEMS, with a focus on the polymer-based microfabrication technologies. Gracias and her co-workers at the University at Albany, State University of New York (SUNY), present the development of an SU-8 microfluidic chip for cell transport studies. Belligundu and Shiakolas from the University of Texas at Arlington introduce a two-stage hot embossing microfabrication method that begins with a positive master and is capable of replicating small and large features in a single step. Chang-Yen and Gale from the University of Utah describe the development of a practical, multianalyte, optical biosensor on a microfluidic polydimethylsiloxane (PDMS) chip. Yang et al. from Tsinghua University in China discuss numerical and experimental studies on the development of a microscale piezoelectric diaphragm air pump capable of large flows and low power consumption. Finally, in the second paper from the University at Albany (SUNY), Olson et al. present the development of an integrated cantilever for acoustic scanning probe microscopy. These papers represent a brief glimpse into this fast evolving field, and hopefully provide a preview of where BioMEMS and microfluidic technologies are heading.

Wanjun Wang
Louisiana State University

Ian Papautsky
University of Cincinnati

Guest Editors