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PREFACE

Special issue on "Optofluidics"

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Optical devices which incorporate liquids as a fundamental part of the structure can be traced at least as far back as the eighteenth century when rotating pools of mercury were proposed as a simple technique to create smooth mirrors for use in reflecting telescopes. Modern microfluidic and nanofluidics have enabled the development of a present day equivalent of such devices centered on the marriage of fluidics and optics which has come to be known over the last few years as "Optofluidics." Recent review articles by two of the pioneering groups in the field, namely the Psaltis (Psaltis et al. 2006) and Eggleton (Monat et al. 2007) groups, as well as a number of conferences and conference sessions have helped to distinguish Optofluidics as a separate research field rather than a simple subdiscipline of either microfluidics or optics. Building on these earlier efforts, this special issue represents the first attempt to bring together a collection of journal papers spanning the areas of interest of prestigious investigators in the field.

Rather than attempt to provide a formal definition of Optofluidics here, (readers interested in something concise can consult the review articles referenced above) I will let the list of contributed articles define it themselves. One of the first successful implementations of true optofluidic technology was in the use of liquid core waveguiding structures. Two articles on the subject have been contributed to this special issue. "Optofluidic Waveguides: I. Concepts and Implementations" from Holger Schmidt at the University of California, Santa Cruz examines the use these devices for on-chip bioanalytics. "Optofluidic Waveguides: II. Fabrication and Structures" from Aaron Hawkins at Brigham Young University details some of the advanced fabrication and integration techniques used in these devices. Li and Psaltis from the California Institute of Technology have contributed a review paper entitled "Optofluidic Dye Lasers" describing the very exciting work being done by their group and others on the development of microfluidics-based tunable dye lasers. The Levy group at the Hebrew University of Jerusalem has contributed an article on the use of microfluidic structures to tune optical elements. The article "Tunable Optofluidic Devices" covers application areas ranging photonic devices to biomedical sensors. The Eggleton group at the University of Sydney has collaborated with teams at Tufts University and RMIT University in Melborne to provide the review entitled "Optofluidics—a novel generation of reconfigurable and adaptive compact architectures". Their article covers a wide range of different optofluidic device structures, many of which nucleated from their early works on the subject. Mortensen and collaborators have presented an extensive, largely theoretical review outlining some of the exciting possibilities for integrating fluidic elements with traditional photonic crystals in their paper "Liquid-infiltrated photonic crystals—enhanced light–matter interactions for lab-on-a-chip applications". In their paper "Nanohole Arrays in Metal Films as Optofluidic Elements: Progress and Potential" Sinton, Gordon and Brolo examine the potential applications for metallic nanohole arrays in microfluidic devices. Interestingly, the review goes beyond the traditional sensing applications to also discuss the possibilities of using these elements for other functionalities including particle trapping. The Yang group at KAIST in Korea have examined the uses of colloidal structures for optofluidic elements in their paper "Optofluidics Tech-

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nology Based on Colloids and their Assemblies". A number of advantages of these devices are covered along with a discussion of some new sensing modalities. Hunt and Wilkinson at the University of Southampton present a very comprehensive review of "Optofluidic Integration for Microanalysis" which broadly covers the related technology being developed for on chip chemical and biochemical analysis. My group at Cornell University has also contributed a review paper entitled "Nanobiosensors: optofluidic, electrical and mechanical approaches to biomolecular detection at the nanoscale." In our paper we have attempted to provide a comprehensive review of nanoscopic biomolecular detection technologies with a focus on ultralow mass detection. Note that majority of the contributed articles assembled here include a strong review component, providing a good overview of the other ongoing research within the authors' specific field of interest. Helpfully for those hoping to break into the field, most articles also end up with some suggestions for future research.

Before closing I would like to thank all the prestigious groups of authors who have taken the time to contribute papers for this issue. It is my sincerest hope that the readers of these articles can be inspired to help grow the field.

References

Monat C, Domachuk P, Eggleton BJ (2007) Integrated optofluidics: a new river of light. Nat Photonics 1(2):106–114

Psaltis D, Quake SR, Yang CH (2006) Developing optofluidic technology through the fusion of microfluidics and optics. Nature 442(7101):381–386