Microfluidics Made Easy

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Despite of its promising impact, microfluidics technology still remains predominantly in the engineering domain. Due to the fabrication requirements for specialized equipment and clean room environment, the implications of microfluidics in the biological and clinical labs still remains largely unexplored. Nonlithographic fabrication, print-and-peel (PAP),[1] allows for expedient and facile device prototyping, offering key venues for expanding of the microfludics application beyond their current realm.[2] This presentation will review the development of PAP. Although the first report for PAP dates back to 2001,[3] its development has been truly accelerated in the past few years.[1,2,4,5]

The second part of the presentation will focus on a paradigm that not only demonstrates the impact of PAP on the broadening the lab-on-a-chip technology, but also heavily relies on steady-state imaging of dynamics systems: **space-domain time-resolved spectroscopy**. We developed devices that utilize the dynamics of laminar microflows for time-resolved emission measurements with steady-state excitation and detection used solely in DC modes of operation. PAP microfabrication approaches, developed in our lab,[1,6] allowed us to prototype the microfluidic devices for time- resolved measurements in a facile and expedient manner. We tested the performance of the devices on lanthanide (III) chelates with 2,6-dipicolinic acids (DPA), a natural product occurring in bacterial endospores that provides a handle for monitoring potential pathogens.

Our microfluidics work in bacterial biosensing[1] lead us to an important insight about the dynamics of staining as a key characteristic of bacterial species, which will be the third part of the presentation. We observed that the kinetics of fluorescence staining, quantified as a time constant of the bacterium-induced emission enhancement, does not manifest concentration dependence (i.e., a pseudo first-order behavior).[7] Concurrently, the kinetics did depend on the dye-bacterium pairs and was statistically discernable for the different species that we investigated.[7] This finding presents an important venue for bringing the bioanalytical methodologies beyond their century-old tradition of Boolean logic.

Simplicity and expedience are some of the key advantages of the demonstrated PAP and pathogen-sensing methodologies. We believed that making device prototyping easy will significantly facilitate and expand the biomedical and clinical application of microfluidics.

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