Invited Paper

Lab-on-a-chip Biomedical Devices for Point-of-Care Clinics

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Abstract

The rapidly increasing healthcare cost in developed countries and the urgent need for improved healthcare service in resource limited regions have created strong needs for low cost, high performance, and easy-to-operate medical devices for diagnostics and treatments of diseases. Lab-on-a-chip devices that integrate microfluidic, MEMS, photonic, and electronic technologies have offered significant promise to fulfill this goal. Progress has been made in many fronts for lab-on-a-chip devices, especially in areas of early and quick diagnosis of various diseases and abnormalities in health.

In this talk we will discuss lab-on-a-chip cell assays and molecular assays for in-vitro point-of-care diagnosis. A common thread of these assays is to replace expensive, bulky, and sophisticated biomedical instruments and procedures used in major hospitals and medical facilities with low cost, easy to operate, and compact devices while producing accurate and reliable results for diagnosis and prognosis. We will give a few examples of such devices, including portable flow cytometers with cell sorting capabilities, label-free image-based cell analyzer that can be coupled with cellphones and other portable electronics, cell-free DNA and miRNA based detection methods for different diseases, to name a few. Another feature that is particularly important for point-of-care applications is biomedical sample acquisition and processing. These lab-on-a-chip devices are designed to handle a small amount (microliters) of blood and biofluid samples taken with minimum invasiveness. Some of the methods are label free, and others have much more simplified sample preparation protocols than today's practices.

Point-of-care, together with personalized medicine, remote medicine, and preventive medicine, set the trends for medicine in the 21st century. We believe lab-on-a-chip technologies will play an increasingly important role by offering fast, accurate, and vital health information in the most cost effective manner. By presenting a few examples based on our own research in this area, we wish to introduce the core technologies, the challenges, and promises of this emerging field to the audience.