Fluorescence Activated Cell Sorting (FACS) System Based on Focused Traveling Surface Acoustic Waves (FTSAWs)

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Fluorescence Activated Cell Sorting (FACS) is an essential technique widely used in biomedical analyses. Microfluidics, benefiting from its low power and sample consumption, has enabled miniaturization of the existing bulky and complex FACS equipment into cost-effective and benchtop devices. However, these devices still have limited efficiency and biocompatibility with sorting mechanisms based on dielectrophoresis, optical tweezers and gas valve. Acoustophoresis, the migration of particles in an acoustic field, has recently emerged as a promising method to manipulate microscale particles in aqueous solutions, thanks to the rapid response and good biocompatibility. In this work, we present a new microfluidic FACS system that makes use of a highly focused traveling surface acoustic wave (FTSAW) for highly accurate sorting. The ~30 μm wide FTSAW is produced by a set of circular-arc interdigital transducers (IDTs) patterned on a piezoelectric substrate. Since the aperture of the FTSAW field becomes comparable to the size of individual biological cells, it enables single particle level sorting even in a high concentration particle suspension upon the activation of fluorescence detection. Separation of tumor cells from white blood cells will be demonstrated to showcase the single cell sorting capability of the developed acoustic FACS system with sub-ms acoustic actuation.

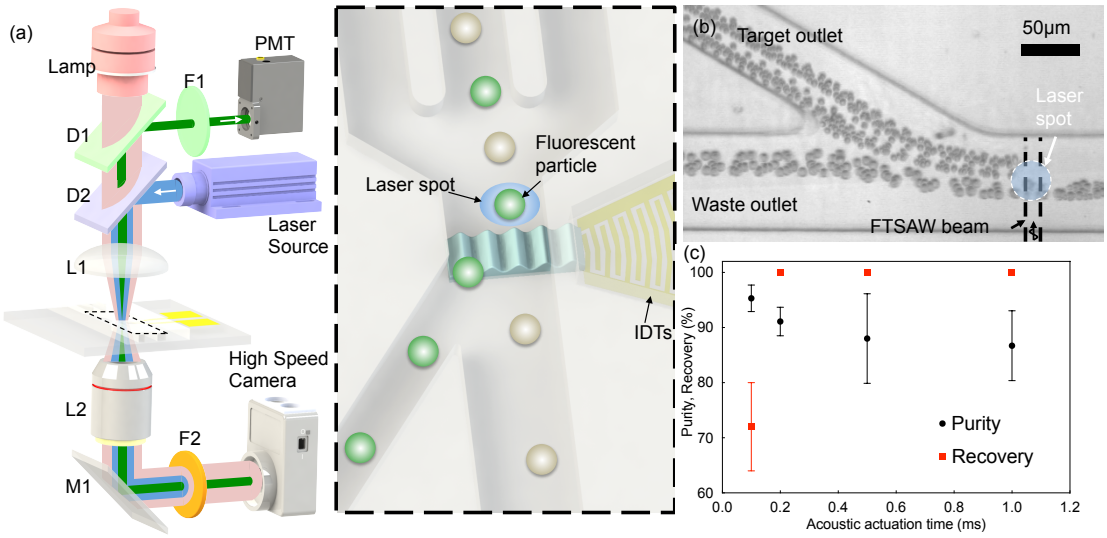

Fig. 1. (a) Schematic illustration of our acoustic fluorescence activated cell sorting (FACS) system. (b) Time-lapsed photos of the particles sorting process based on their fluorescent label. (c) Correlation between the sorting performance (purity and recovery) and the acoustic actuation time of each sorting event.