**Lensfree Fluorescent Microscopy**

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**Summary:** A lensfree on-chip fluorescent microscopy platform is demonstrated that can image fluorescently labeled cells or small model animals over an ultra-wide field-of-view of e.g., >0.648 cm² with <4µm resolution using sparse signal recovery based decoding. Such a compact and wide-field fluorescent on-chip imaging modality could be valuable for high-throughput cytometry, rare-cell analysis as well as for microarray research.

Optical microscopes enable us to see micron sized objects with high sensitivity and resolution. However, the field-of-view (FOV) of conventional lens-based imaging systems is typically limited to less than a few mm² which in general requires mechanical scanning to image e.g., the entire area of large lab-on-a-chip platforms. To address this limitation, here we demonstrate an on-chip microscopy platform [1-4] that can image fluorescently labeled cells or small model animals (e.g. *C. Elegans*) over a wide FOV of >0.6-8 cm², achieving <4µm resolution without the use of any mechanical scanners, bulky optical components, lenses or thin-film based interference filters.

In this lensless on-chip microscopy platform (Fig. 1), the fluorescent excitation is achieved through a prism or hemispherical-glass interface that is illuminated by an incoherent source (e.g., a simple fiber-coupled light-emitting diode). After interacting with the entire object volume, this excitation light is rejected by total-internal-reflection (TIR) process that is occurring at the bottom facet of the sample micro-fluidic chip. With the removal of weakly scattering excitation using an inexpensive absorption filter, only the fluorescent emission from the excited objects can be collected by a fiber-optic faceplate or a taper and can be delivered to an optoelectronic sensor array such as a charge-coupled-device (CCD) or a Complementary metal–oxide–semiconductor (CMOS). By using a sparse signal recovery algorithm, [2] the acquired lensfree raw fluorescent images of the sample can be rapidly processed to yield e.g., <4µm resolution over an FOV of >0.6-8 cm². A typical wide-field lensfree fluorescent image acquired with our platform is illustrated in Fig. 1 for SYTO®16 labeled white-blood cells in a lysed whole blood sample. For comparison purposes, a conventional 10X objective-lens based fluorescent microscope image of the same cells is also demonstrated in the same figure. This compact and wide-field on-chip fluorescent imaging platform, with rapid digital decoders behind it, could be rather valuable for high-throughput cytometry, rare-cell analysis and microarray research.