

文献综述：Optofluidics

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2019.05.25

Reference: Sihui Chen et al., "Optofluidics in bio-imaging applications" , Photonics Research, 2019.

定义

- Original: optofluidics is capable of manipulating light with on-chip fluidic processes or using light to control fluidic entities.
- advanced optical/photonics methods to enhance performance of the system

出现原因

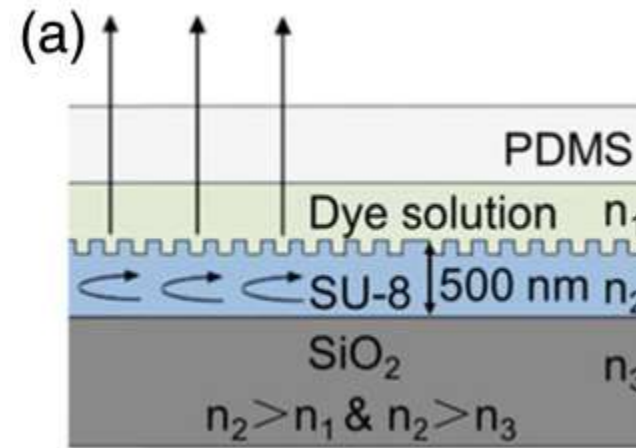
- most imaging system have come close to practical limits
- compatibility between sample and imaging systems

Components

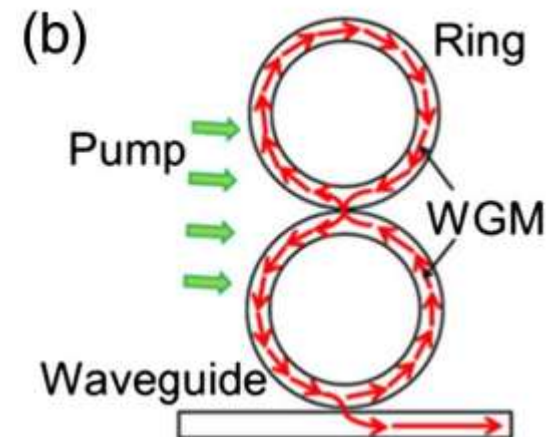
1. Optofluidic Lasers
2. Optofluidic Prisms
3. Optofluidic Switches
4. Optofluidic Lenses

Optofluidic Lasers

1. based on a Fabry-Perot resonator
2. based on distributed-feedback gratings



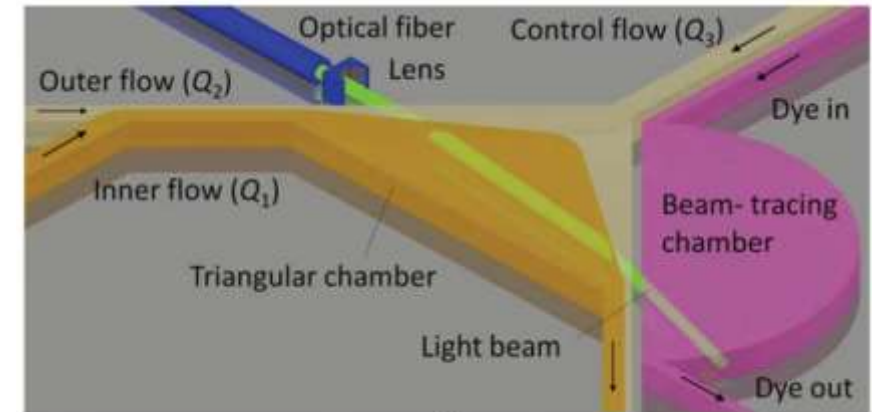
3. optofluidic ring resonator laser system ($Q = 1000$)



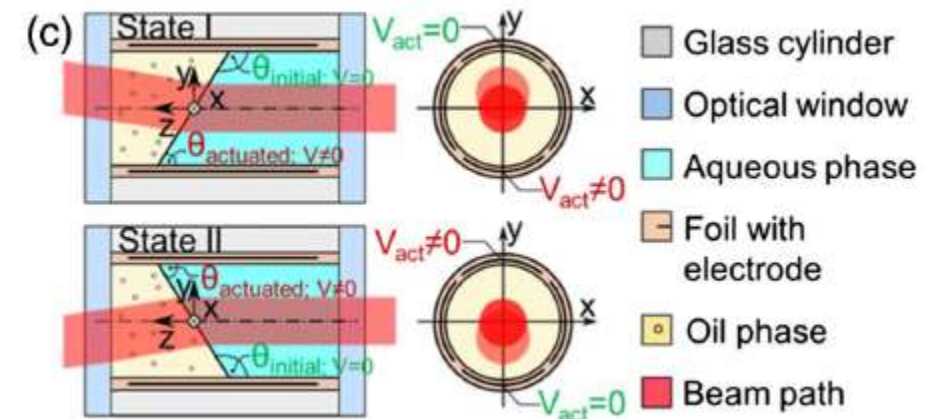
Optofluidic Prisms

use an optofluidic prism to manipulate the light path

1. converging three laminar flow streams



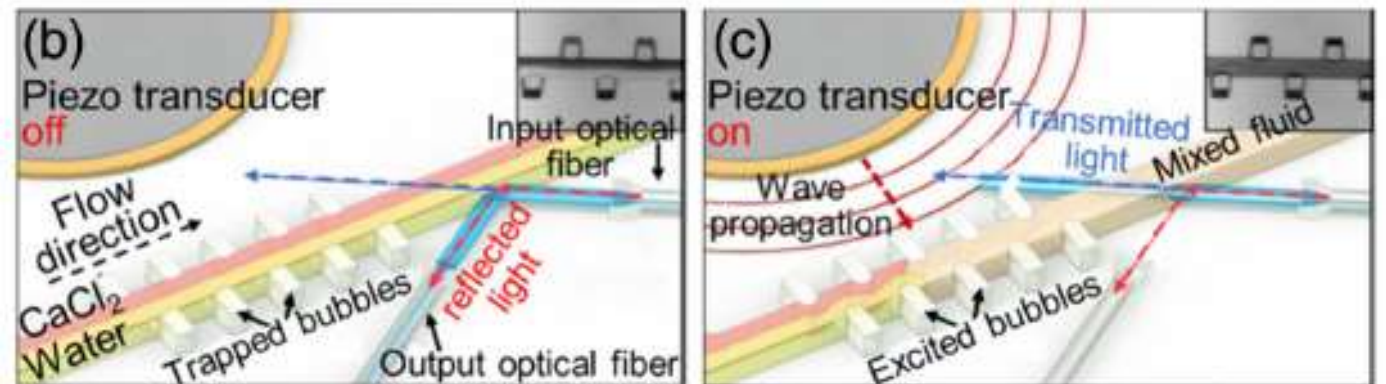
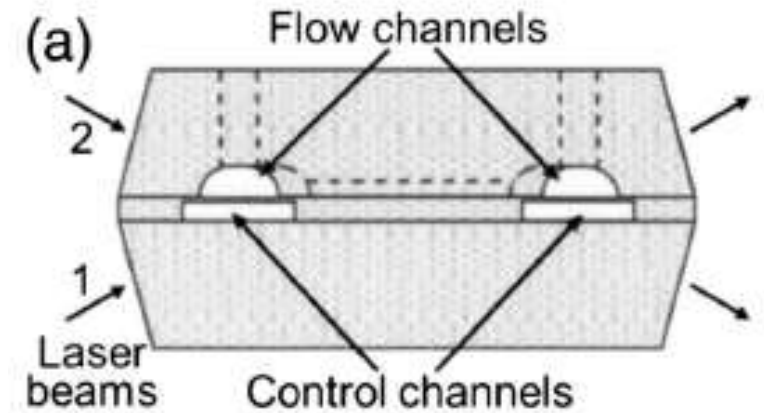
2. rotatable optofluidic prism



Optofluidic Switches

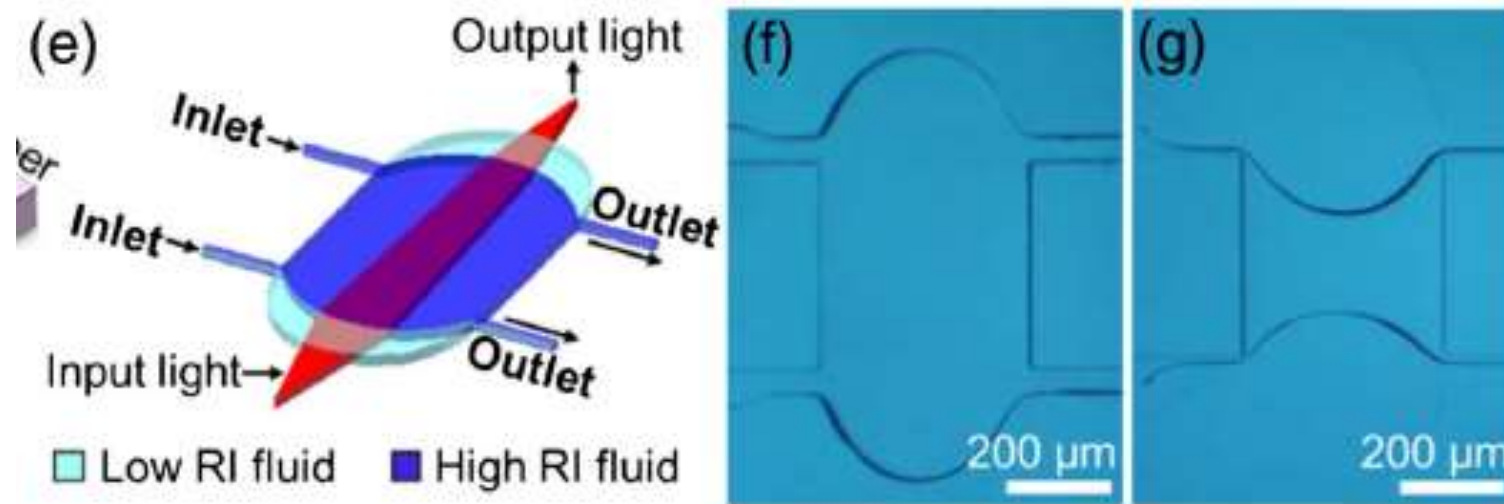
modify light path and intensity, both based on total internal reflection

1. by tuning the index of the mirror channel medium
2. turn on/ turn off piezoelectric transducer



Optofluidic Lenses

- By tuning the flow rates of the streams



Challenges

1. unstable and temperature-dependent
2. flow control

Optofluidic Imaging Methods

lens-based (most are SPIM)

obstacles

bulky instruments,

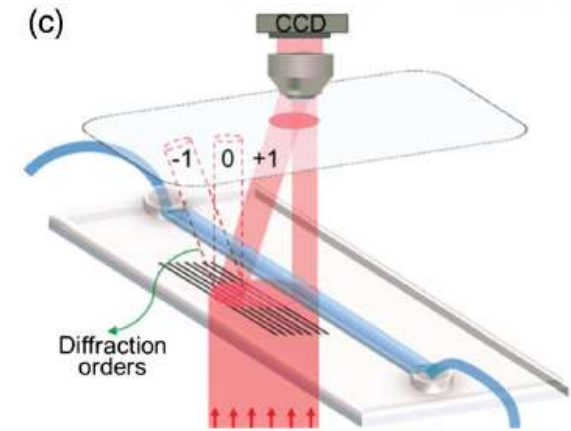
diffraction-limited resolution,

trade-off between field-of-view and resolution

lens-free

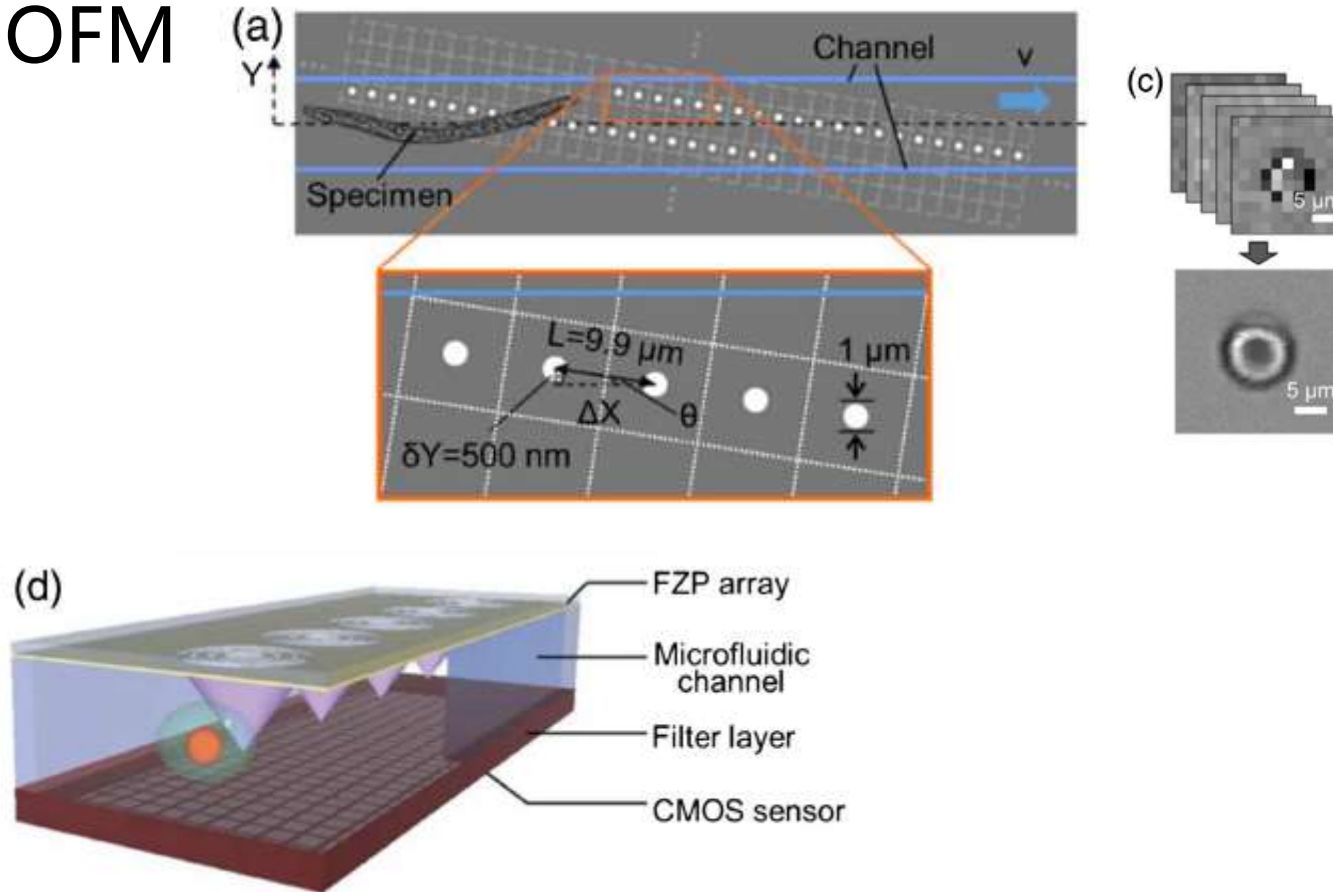
microscope

tomographic microscope

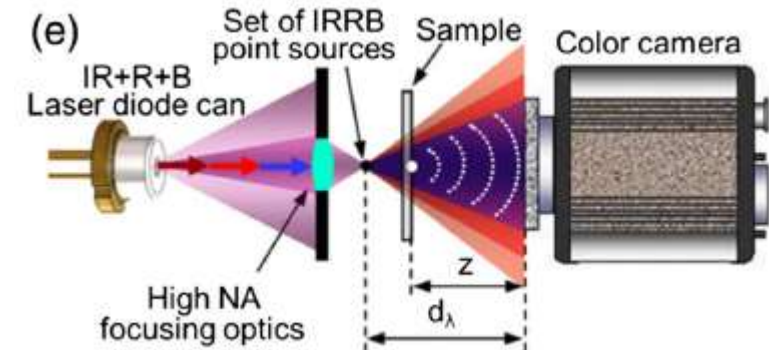


Optofluidic microscope

OFM



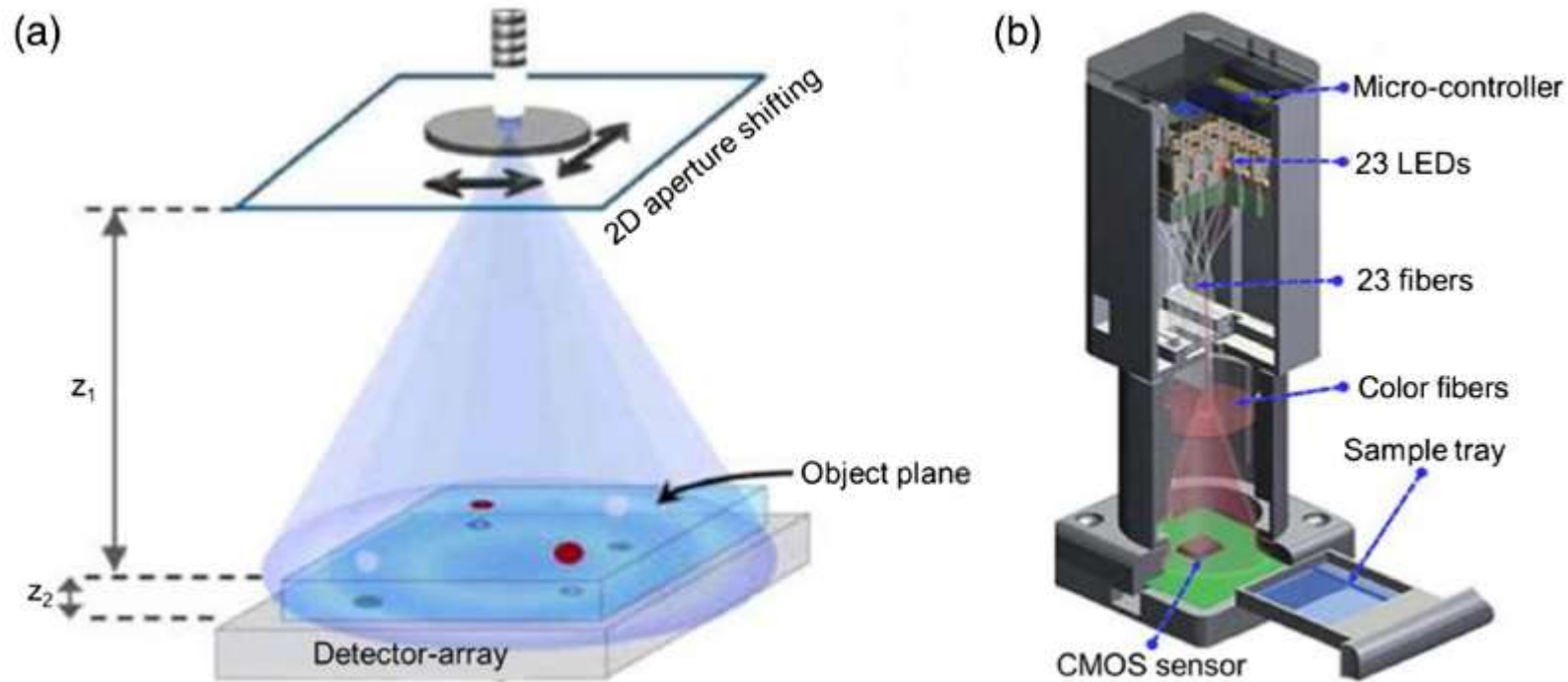
1. aperture: $< 1 \mu\text{m}$
2. CMOS/ CCD
3. resolution: 800 nm
4. rearranging 40–50 raw images into a SR image



Fresnel zone plate (FZP) arrays act as high-NA microscope objective lenses and focus illumination light into a nanoscale.

slightly laterally and axially shifted point sources (RGB) below the sample

Tomographic Microscope



single perspective holography provides individual 3D sectioning information

Ultra-fast imaging

- The core concept of optical time-stretch imaging is to retrieve spatial information from the “time-stretch” spectrum in the one-dimensional (1D) temporal data stream.
- Wong et al. $\sim 100,000$ cells/s

