Single Molecule Imaging and Sizing of DNA on a Cell Phone

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SUMMARY

UCLA researchers in the Department of Electrical Engineering have developed a light-weight and cost-effective fluorescence microscope installed on a cell phone.

BACKGROUND

Optical methods for imaging single biomolecules allow for exploration of their individual behavior and properties at nanoscale, which not only significantly advances our knowledge of molecular biology and biophysics but also provides various diagnostics opportunities for biomedical applications.

Imaging of single DNA molecules has been of particular interest as various diseases including cancer and neurological disorders such as Alzheimer's disease are associated with genomic alterations, including for example copy number variations (CNVs). High spatial resolution and nondestructive nature of optical imaging methods are especially attractive for probing DNA-protein interactions or mapping genetic information from individual DNA molecules.

These research and development efforts, however, have been mostly limited to advanced laboratory facilities using relatively costly, complex and bulky imaging set-ups, including for example confocal fluorescence microscopy, super-resolution microscopy, or label-free plasmonic imaging.

INNOVATION

Researchers at UCLA have developed a compact, light-weight and cost-effective fluorescence microscope, installed on a mobile-phone, that can image and quantify length of single molecule DNA strands. This optical attachment creates a high contrast dark-field imaging set-up using an external lens, thin-film interference filters, a miniature dovetail stage and a laser-diode for oblique-angle excitation. The lab was able to image single DNA molecules with a sizing accuracy of <1 kilobase-pairs over ~2 mm^2 field-of-view.

APPLICATIONS

Cost-effective alternative to advanced biomedical imaging and measurement tools, particularly in developing countries and resource-limited institutions

ADVANTAGES

- Compact and lightweight compared to full fluorescent microscopy set-up
- Less expensive
- Cell phones are widely used

RELATED MATERIALS

- Zhu, Hongying, Sam Mavandadi, Ahmet F. Coskun, Oguzhan Yaglidere, and Aydogan Ozcan. "Optofluidic fluorescent imaging cytometry on a cell phone." Analytical chemistry 83, no. 17 (2011): 6641-6647.
- Zhu, Hongying, Oguzhan Yaglidere, Ting-Wei Su, Derek Tseng, and Aydogan Ozcan. "Cost-effective and compact wide-field fluorescent imaging on a cell-phone." Lab on a Chip 11, no. 2 (2011): 315-322.
- Zhu, Hongying, Uzair Sikora, and Aydogan Ozcan. "Quantum dot enabled detection of Escherichia coli using a cell-phone." Analyst 137, no. 11 (2012): 2541-2544.

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Imaging, fluorescent imaging, DNA, cell phone, portable imaging, portable microscope, fluorescent microscope, DNA imaging, dark-field imaging, laser-diode

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - Medical
  - Molecular
- **Medical**
  - Research Tools
- **Research Tools**
  - Other
- **Sensors & Instrumentation**
  - Scientific/Research
- **Engineering**
  - Other

RELATED CASES

2015-153-0

▶ Bishara, Waheb, Hongying Zhu, and Aydogan Ozcan. "Holographic opto-fluidic microscopy." Optics express 18, no. 26 (2010): 27499-27510.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,248,838	04/02/2019	2015-153

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ Automated Semen Analysis Using Holographic Imaging
- ▶ Extended Depth-Of-Field In Holographic Image Reconstruction Using Deep Learning-Based Auto-Focusing And Phase-Recovery
- ▶ Detection and Spatial Mapping of Mercury Contamination in Water Samples Using a Smart-Phone
- ▶ Computational Cytometer Based On Magnetically-Modulated Coherent Imaging And Deep Learning
- ▶ Lensfree Tomographic Imaging
- ▶ Cross-Modality Deep Learning Brings Bright-Field Microscopy Contrast To Holography
- ▶ Microscopic Color Imaging And Calibration
- ▶ Quantification Of Plant Chlorophyll Content Using Google Glass
- ▶ Rapid, Portable And Cost-Effective Yeast Cell Viability And Concentration Analysis Using Lensfree On-Chip Microscopy And Machine Learning
- ▶ Holographic Opto-Fluidic Microscopy
- ▶ Design Of Task-Specific Optical Systems Using Broadband Diffractive Neural Networks
- ▶ Ultra-Large Field-of-View Fluorescent Imaging Using a Flatbed Scanner
- ▶ Revolutionizing Micro-Array Technologies: A Microscopy Method and System Incorporating Nanofeatures
- ▶ Tunable Vapor-Condensed Nano-Lenses

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