Topic No. 5.03 Single Cell Analysis Abstract Reference No: 0529

Oral

CELL REFRACTIVE INDEX IMAGING FOR REAL-TIME VIRUS INFECTION

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This paper presents a new optofluidic detection system to measure the absolute refractive index map of host cells. This new system: cell refractive index tomography, can measure the absolute refractive index map of host cells. During virus infection, cell morphology and the intracellular contents of the host cells are changed. Such changes can be monitored by detecting the refractive index variation. By monitoring of the cell's refractive index, the detection of virus infection in real-time and label-free is determined.

Figure 1 shows the schematic illustration of the cell refractive index (RI) tomography platform: (1) cell culture on-chip (2) perfusion for long-term medium refreshment and (3) virus injection for infection.

Figure 2 shows the schematic diagram of the tomography microscope setup. MDCK cells are seeded on a sample microchip and place in the tomographic diffractive microscopy. A total of 268 phase images have been captured and an example of MDCK cell is shown in Fig. 3. Based on these 268 phase images, a 3D refractive index map has been constructed.

Figure 3 and Figure 4 shows an example of MDCK cell in mock infection and after infection by influenza virus. The RI analysis of the cells is shown in Figure 5 and 6. The trend of change for average RI of the whole cell or cytoplasm is different between non-infected and infected cells. For non-infected MDCK cells, the average RI of cytoplasm is seen increasing, which can be owing to the increase of metabolism after cell starvation. While the average RI of cytoplasm for infected cells is decreasing, this may be due to the decrease of metabolism after cell starvation and virus infection. The trend of nucleus change is not conclusive, indicating that the DNA replication due to cell division and virus infection is not distinguishingly different.

In conclusion, the new platform of common-path tomographic diffractive microscopy was successfully built to measure refractive index of MDCK cells in mock and infection experiments. The results show that infection of influenza virus on MDCK can be identified by observing the change of the cytoplasm within 12 hours.

Word Count: 500

REFERENCES:

1. "Programmed trapping of individual bacteria using micrometer-size sieves," M.-C. Kim, B. C. Isenberg, J. Sutin, A. Meller, J. Y. Wong, C. M. Klapperich, Lab Chip, **11**, 1089 (2011).

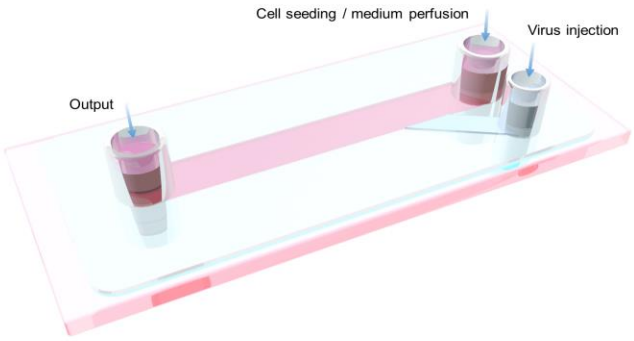

Figure 1: Schematic illustration of the cell refractive index tomography chip.

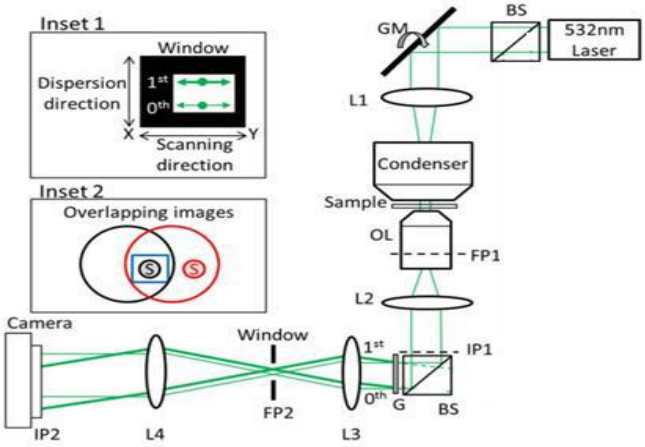

Figure 2: Schematic diagram of the tomograpgy microscope setup. BS, beam splitter; GM, galvanometer mirror; L1, L2, L3, and L4, lenses; OL, objective lens; G, grating; IP1 and IP2, image planes; FP1 and FP2, Fourier planes.

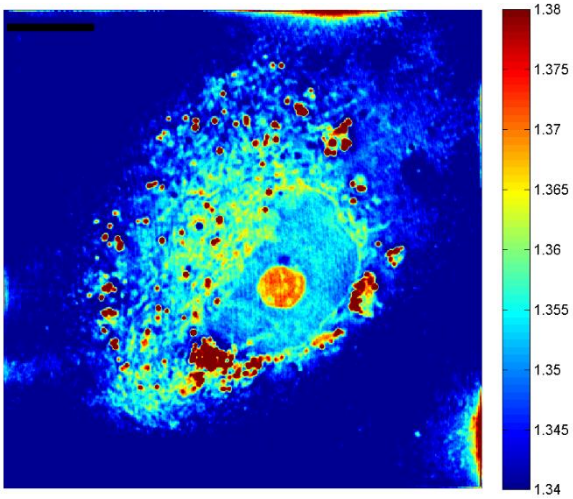

Figure 3: RI map of MDCK cells at mock experiments

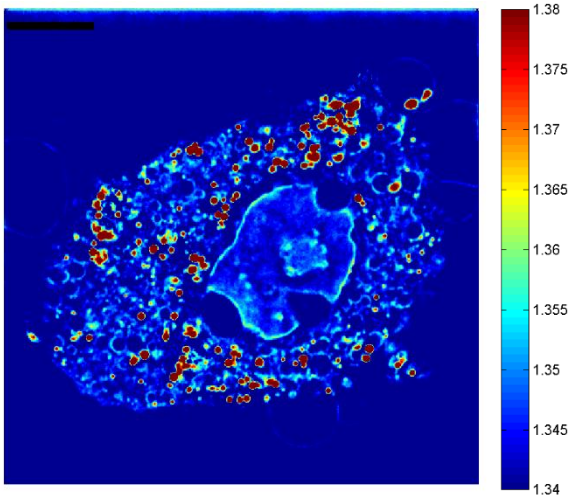

Figure 4: RI map of MDCK cells at infection experiments

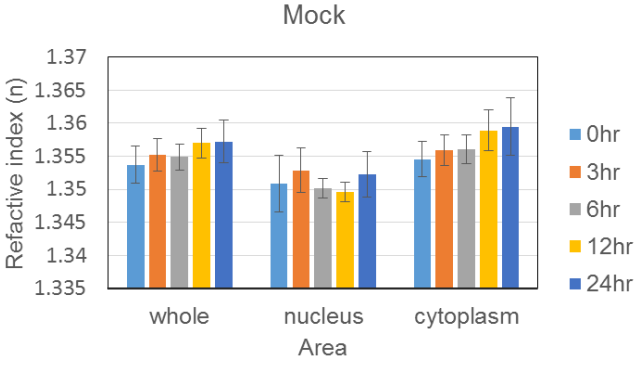

Figure 5: RI analysis of mock infection.

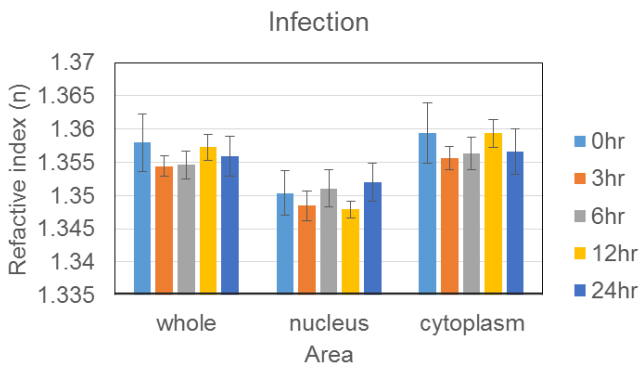

Figure 6: RI analysis of influenza virus infection.