REAL-TIME OPTICAL MONITORING OF CELL CULTURE IN CENTRIFUGAL MICROFLUIDICS

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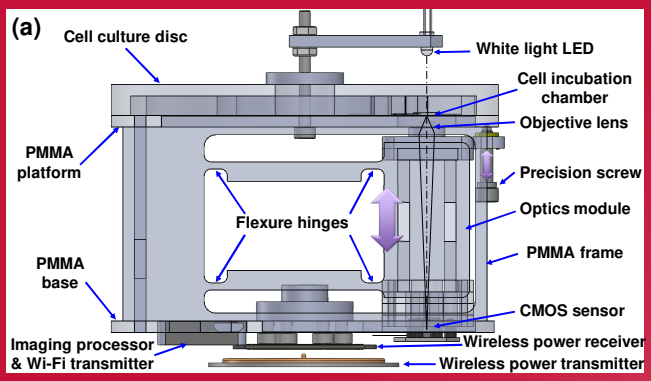
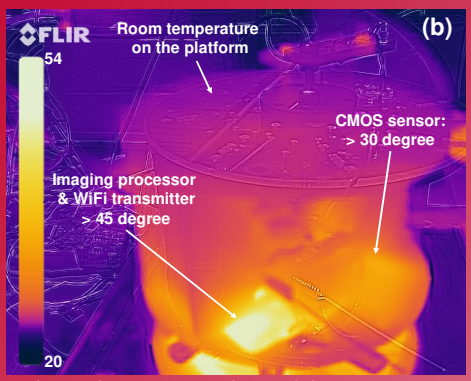
INTRODUCTION

Perfusion model provides cell-based assays: **I. Continuous nutrient supply. II. Active waste removal. III. Lower reagent consumption. IV. Easier environmental parameter control.** We developed perfusion model cell culture on a disc to eliminate the auxiliary perfusion tubing and pump. A wireless optical microscope was developed for observing cells on a disc.



Wireless microscope design combined with a cell culture disc



Thermal imaging analysis of the microscope

Wireless microscope on a spin stand

Microscope **field of view: 400 x 225 μm**. Theoretical **resolution of 200 x 200 nm per pixel**. The Wi-Fi interface enables a **temporal resolution of 30 fps**. A four-linkage flexure provides rigid and linear guiding for the optics module. Fig. (a): a precision screw adjusts the focal point to the cells. A white light LED provides a homogeneous illumination for imaging. Fig. (b) the cell culture disc is not thermally affected by all the heat sources (wireless power, Wi-Fi transmitter and CMOS sensor). The disc was sterilized with sodium hydroxide, rinsed with ultrapure water and phosphate buffer saline and the cell chamber was coated with Matrigel. After coating the culture chamber was filled with cell culture medium and the human cervical cancer cell line (HeLa) were seeded.

RESULTS AND DISCUSSION

Inside an incubator, the microscopic imaging was not affected by the rotational movement. The heat generated by the wireless power and the camera did not interfered with the attachment and proliferation of the HeLa cell. Fig. (d): the microscope can achieve a cellular-resolution and spot a dead cell five hours after seeding. Fig. (e): 2 μm features (inside a dotted circle) on top of the dead cell can be resolved as well. Fig. (f): The cell division process can also be monitored wirelessly and remotely. One drawback is that the microscope can only monitor one spot inside the cell incubation chamber.

CONCLUSION

The preliminary experiment shows that the newly developed wireless microscope is capable of monitoring cell cultivation process and monolayer formation on the cell culture disc. The high resolution of the camera enabled detailed real-time monitoring without the need to remove the culture unit from the incubator as commonly done when imaging cell cultures with traditional microscopes. The optical monitoring and cell cultivation on a disc could be a stepping stone for drug screening assays and various biomedical applications .

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