

**Working distance and magnification power for objective lens  
can be changed in conventional microscope by new image formation theory**

**Satoshi Nishimura**

**Jichi Medical University, Tochigi, JAPAN E-mail : snishi-tky@umin.ac.jp**

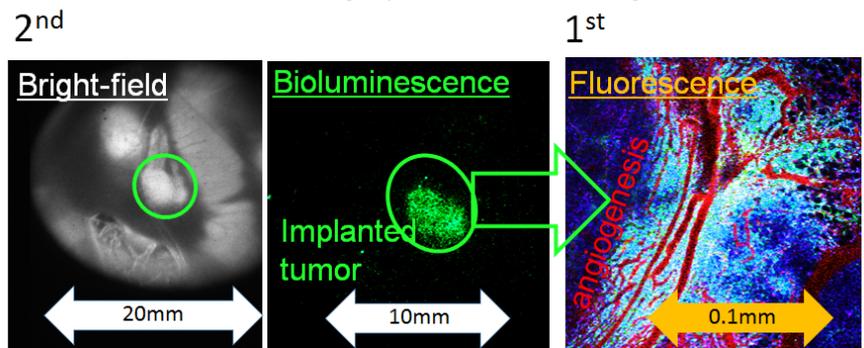
**KEY WORDS :** multi-mode formation, magnification power, working distance, CMOS

With increase of spatial and axial resolution, sample handling is getting much difficult, especially for beginner users. We developed new optical theory which can change formation modes for microscope objective lens, which also alter zooming factors, and working distance. We integrated this system into conventional microscope, and make operations to be precise and much easier. Most of commercially available microscope objective has fixed working distance and magnification power. Image formation is designed by pre-determined spatial relationships of optical modules (objective & tube lens, pinhole, etc), and we named this design “1st position”. However, we also found that another clear image formation can be possible by different module position. “2nd position” scanning is possible by adding zooming liquid lens after tube lens, based on new calculation theory. In these positions, objective lens specification can be changed. Working distance is changed from 10mm to infinite, and magnification power is almost close to zero in 2nd image formation.

Combined use of 1st and 2nd mode in one optical system has several scientific advantages. One is multi modalities scanning by simple optics. In 2nd position, real-time bioluminescent scan is possible by side-port 4/8K CMOS sensors. In microscope designed for fluorescence, we also visualized luciferase signal from implanted tumors in living mice by 2nd modes. Thus, bioluminescence can be merged with two photon fluorescent microscope. Two modalities can be co-existed in one conventional microscope with same sample, lens, and focusing area, which make user handling much easier. (Upper figure)

The other advantage is “microscope manipulation guide”. 2nd position image can help sample handling processes for users, because it revealed broad-field and deep-focusing information in out-of-focus positions. Black-out time for operators can be reduced using this guiding system. In lower figure, left panel shows guide view for eyes and retinas living mice, and right one shows two photon high-resolution image.

Multimodalities scanning by multi-mode image formation



Microscope guide by multi-mode formation

