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All-wavelength and scalable intravital imaging of living mice by nonlinear optics and 8K CMOS sensors

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Recently, needs for covering broad scales and wavelenghs are increasing, but usual optical path for microscope cannot pass infrared and visible light at the same time. We developed new optical theory which can change formation modes, adjust zooming factors, and cover all-wavelength, with combined use of silica glass, germanium, and mirrors. We integrated 8K pixel CMOS imaging sensors, and GaAsP sensing modules by non-linear optical technologies into one system, and enabled hybrid imaging of fluorescence and bioluminescence signals, for same object through one objective lens.

In this system all vasculatures can be visualized including arteries, veins, and lymphatics. Our imaging can open research fields for “in vivo lymphatic kinetics” (Figure 1)

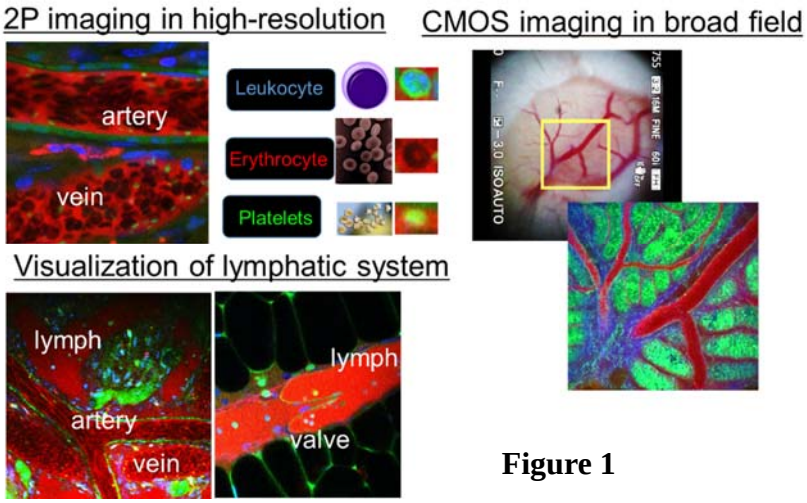

Figure 1

Our system has many advantages for biological applications. One example is thrombus imaging, which is main component of cardiovascular events. We revealed single platelet kinetics in developing thrombus at micro level, and also inter-cellular network responses at macro organ scale with advantage of 8K pixels (Figure 2).

Another advantage of our system is simultaneous analysis of fluorescent and bioluminescent signals. By image intensifier and CMOS imaging on macro modes, we visualized luciferase signals from implanted tumors in real-time manners. At the same location, we also visualized angiogenic responses from host tissues in high spatial resolutions by 2P imaging using fluorescence.

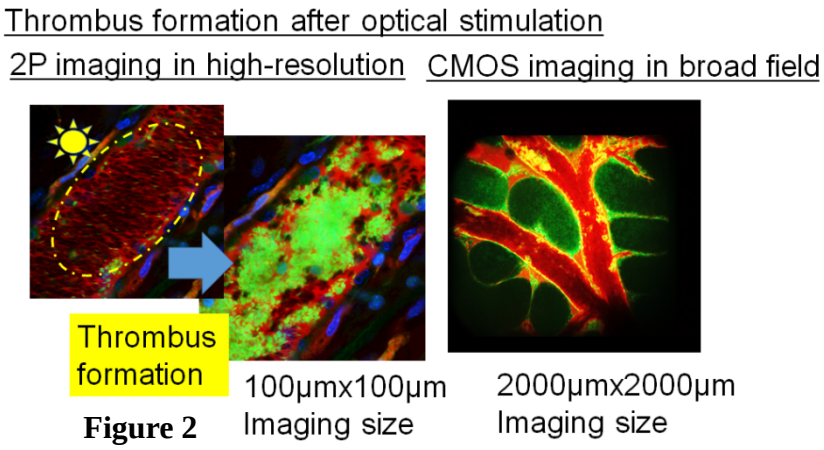

Figure 2

In sum, we covered micro to macro scale in space and time dimensions for intravital observation, and we also covered multi imaging modalities.