

OPTICAL-RESOLUTION PHOTOACOUSTIC MICROSCOPY

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Photoacoustic tomography (PAT), a booming biomedical imaging technique [1], combines optical absorption contrast and ultrasonic detection. It has broken through the imaging depth barrier of high-resolution pure optical imaging methods by using the diffusive photons and conserves the ultrasonic resolution. In addition, PAT also images targets within the ballistic and quasi-ballistic regime with micron or submicron optical resolution, which is achieved by the recently developed optical-resolution photoacoustic microscopy (OR-PAM) [2].

Figure 1 shows a transmission-mode OR-PAM. An optical objective lens focuses the illumination light in sample from one side, and a positively focused ultrasonic detector detects the generated ultrasonic waves on the opposite side. Both focal zones are configured coaxially and confocally, maximizing the PA signals from the optical focal zone. The lateral resolution of OR-PAM is determined by optical focusing. With a 0.6-NA commercial microscope objective and a 532 nm illumination wavelength, we have successfully refined the lateral resolution of our OR-PAM system down to 500 nm. The axial resolution is currently determined by the ultrasonic detection, i.e., the temporal resolution of the ultrasonic detection times the sound velocity.

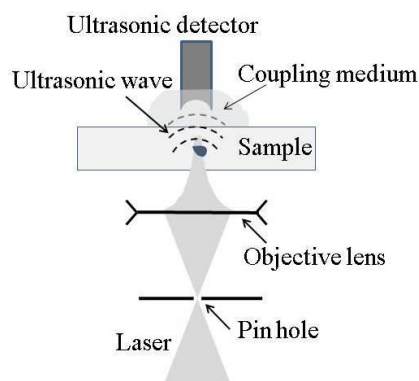


Figure 1: A sample OR-PAM setup

OR-PAM, primarily sensitive to optical absorption contrast, is highly complementary to current high-resolution pure optical imaging methods. Capable of detecting absorption changes with high sensitivity and spatial resolution makes it a powerful tool to study physiological and pathological functional processes in cell or even subcellular organelle scales, such as the monitoring of angiogenesis and microhemodynamics [3] at the capillary level. The current resolution can be further improved by using a higher NA objective lens or a shorter wavelength.

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