Intravascular optical-resolution photoacoustic tomography with a 1.1 mm diameter catheter

With the support from the National Natural Science Foundation of China and Shenzhen Science and Technology Innovation Committee, Prof. Song Liang's laboratory at Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, reported the development of intravascular optical-resolution photoacoustic tomography with a 1.1 mm diameter catheter, which was published in *PLOS One* (2014, 9 (3): e92463).

Photoacoustic imaging is an emerging technology that can provide anatomic, functional, and molecular information about biological tissue. Intravascular spectroscopic photoacoustic imaging can potentially improve the identification of atherosclerotic plaque composition, and ultimately the risk stratification of atherosclerosis. In this study, a first-of-its-kind intravascular optical-resolution photoacoustic tomography (OR-PAT) system with a 1.1 mm diameter catheter is developed, offering optical-diffraction limited transverse resolution as fine as 19.6 mm, 10-fold finer than that of conventional intravascular photoacoustic and ultrasonic imaging. To offer complementary imaging information and depth, the system also acquires co-registered intravascular ultrasound images in parallel. Imaging of an iliac stent and a lipid phantom shows that the high resolution and contrast of OR-PAT can enable improved stent implantation guidance and lipid identification. In the future, these capabilities may ultimately improve the diagnosis and interventional treatment of vulnerable atherosclerotic plaques, which are prone to cause thrombotic complications such as myocardial infarction and stroke.

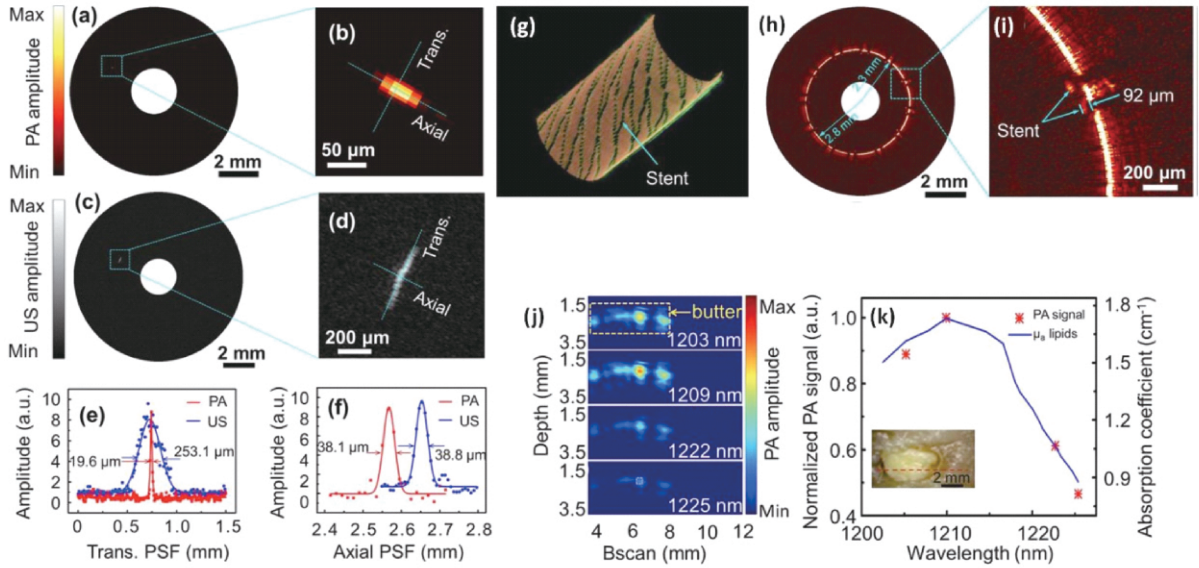

Figure (a) Photoacoustic B-scan image of a carbon fiber (6μm in diameter). (b) Enlarged view of the dashed box in (a). (c) Ultrasound B-scan image of a tungsten wire (12 μm in diameter). (d) Enlarged view of the dashed box in (b). (e) The transverse and (f) axial resolutions of photoacoustic (red) and ultrasonic (blue) imaging with OR-PAT. (g) Three-dimensional cut-away photoacoustic image of a stent deployed in a plastic tube. (h) Representative photoacoustic B-scan. (i) Enlarged photoacoustic image corresponding to the dash boxes in (h). (j) Photoacoustic images at four different laser wavelengths of a lipid phantom (see inset in (k)). (k) Comparison between the acquired photoacoustic spectrum and the known optical absorption spectrum of lipid.