A 0.5 mm resolution mouse brain PET for simultaneous two-photon excitation imaging

◦Han Gyu Kang[1], Hiroyuki Takuwa[1], Hideaki Tashima[1], Hidekatsu Wakizaka[1], Makoto Higuchi[1], Taiga Yamaya[1]

QST[1], E-mail: hangyookang@gmail.com

Simultaneous positron emission tomography (PET) and two-photon excitation fluorescence (TPEF) imaging has a potential to decode mouse brain function from molecular to cellular levels. Here, we developed a small animal PET scanner that can be combined with the TPEF microscope for simultaneous PET and TPEF imaging of mouse brain. This scanner has two open spaces, one is for mouse placing, and the other one is for inserting the TPEF microscope. The scanner has a 52.5 mm inner diameter and 24.5 mm axial FOV. The LYSO crystal array has the pixel pitch of 1 mm and total thickness of 15 mm. There are two detector rings each of which has 16 DOI detectors. Each DOI detector consists of a 3-layer staggered LYSO crystal array and 4×4 SiPM array with a pixel pitch of 3.2 mm. The SiPM anode signals are multiplexed using a resistive network and then digitized by a custom-made DAQ. The coincidence data are generated by using coincidence process software with a coincidence window of 10 ns. The measured spatial resolutions at the center and 5 mm radial offset are 0.89 mm and 0.87 mm for FBP, respectively. Using the OSEM, we are able to separate rods of 0.75 mm in diameter. The peak absolute sensitivity is 1.35% with an energy window of 400-600 keV. In conclusion, we successfully developed the small animal PET scanner that can be combined with a commercial TPEF microscope. We are ready to carry out the simultaneous PET and TPEF imaging of a mouse brain using hybrid radio-optical tracers.

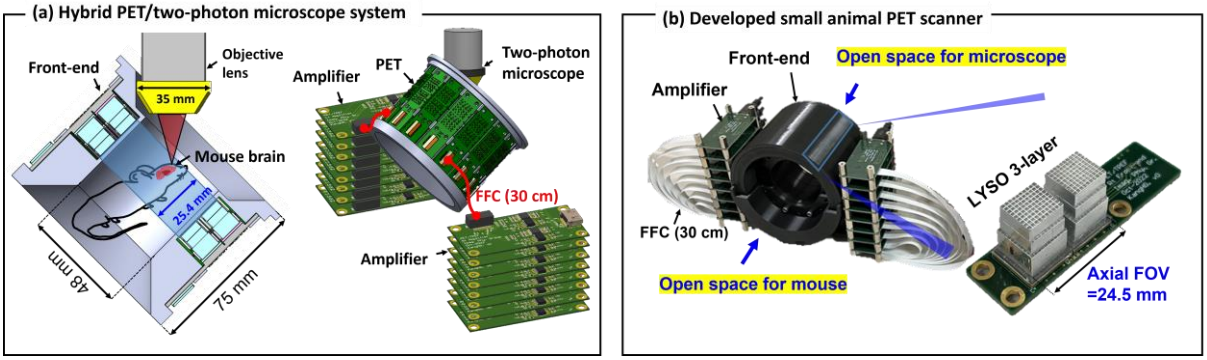

Fig. 1. (a) The proposed hybrid PET/TPEF imaging system and (b) the developed small animal PET scanner.

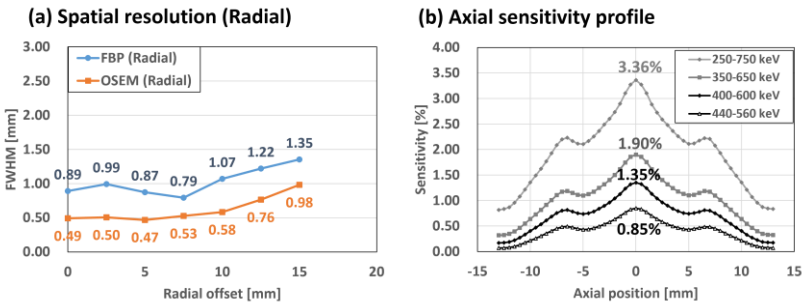

Fig. 2. (a) The radial spatial resolution and (b) axial sensitivity of the PET scanner.

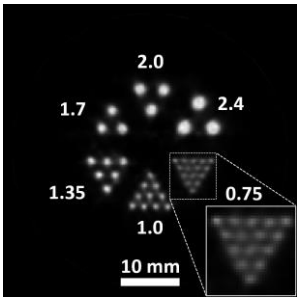

Fig. 3. (a) The reconstructed PET image of a resolution phantom with the OSEM