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Feasibility test of high-speed phase-contrast X-ray computed tomography

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Introduction

Phase-contrast X-ray imaging, which uses phase-shifts caused by samples as image contrast, is a powerful tool for biomedical imaging. Since the phase-shift cross-section of light elements is about 1000 times larger than absorption-cross sections, samples mainly consist of light elements, such as biological soft tissues and organic materials, can be observed clearly without using any contrast agents. We developed an imaging system fitted with a two-crystal X-ray interferometer [1] and used it for *in vivo* observation of tumors implanted in nude mice [2] and drug effect on tumors [3]. For wider application of this imaging system, we have developed a fast and high sensitivity CCD-based X-ray digital imager [4] and adopted for the imaging system to shorten the measurement period.

Feasibility test results

The feasibility test of phase-contrast X-ray computed tomography (CT) was performed using 17.8-keV X-ray at BL-14C1. Figure 1 shows a three-dimensional image (a) and sectional images (b) obtained for a rat kidney. The total measurement period was about 10 min. The exposure time to obtain one interference image was 0.5 s, and the phase shift caused by sample was detected by a 3-step fringe scanning method. The CT projection number was 200 (0.9° /step), and sectional images were reconstructed by a filtered back-projection method with the Shepp-Logan function. The binning mode of the imager was set at 2 × 2 (pixel size was 25 μm square). Various soft tissues such as renal pelvis, that would normally need contrast agents to be seen, were clearly visualized. Cortex and medulla tissues were also able to be identified without using any contrast agents. The density resolution calculated from standard deviations of phase fluctuations in the background area was 1.7 mg/cm^3.

References

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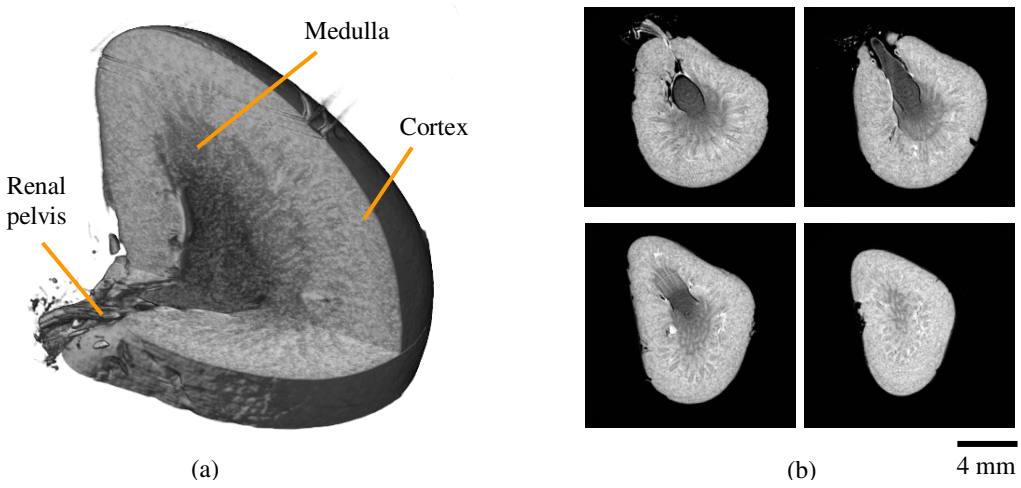

Fig. 1 Three-dimensional image (a) and sectional images (b) of rat kidney. The total measurement period was 10 min.