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Phase-contrast x-ray CT for biomedical application at 35keV

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Introduction

Phase-contrast x-ray imaging with an x-ray interferometer, is a powerful tool to reveal the structures inside soft tissues without the use of a contrast agent

because this technique has 1000-fold higher sensitivity than that of the conventional absorption method [1]. Phase-contrast x-ray CT (PCCT) demonstrated various inner structures of rabbit cancer [2] and human cancer [3]. For observing the larger objects, phase-contrast x-ray imaging systems with larger monolithic x-ray interferometer [4] and a two-crystal interferometer [5-7], have being developed to obtain a field of view with 25 mm x 25 mm at 17.7 keV. Since the x-ray exposure to large object increases significantly at low x-ray energy of 17.7 keV and the object with steep phase gradient can not be imaged by the interferometer based phase-contrast x-ray technique, phase-contrast x-ray imaging was examined at high x-ray energy of 35 keV and succeeded [8, 9]. We described PCCT image obtained at 35 keV.

Methods and material

The phase-contrast x-ray imaging system consisted of a Si (220) asymmetric cut crystal, a monolithic x-ray interferometer, a phase-shifter, an object cell and an x-ray CCD camera. An experiment was performed at a vertical wiggler beam line of the Photon Factory. The x-ray energy was set at 35 keV. The cell was placed in a beam path between mirror and analyzer of the interferometer. PCCT image of whole rat kidney fixed by formalin was obtained.

Results and discusion

At 35 keV x-ray energy, PCCT image showed inner renal structures of rat such as renal pelvis, medulla and renal cortex (Fig.1). Image quality at high x-ray energy is not degraded significantly by visual inspection comparing to previous study [3,8]. To acquire CT data much faster for biomedical researches, x-ray CCD camera with high speed data acquisition will be needed instead of presently used x-ray detector.

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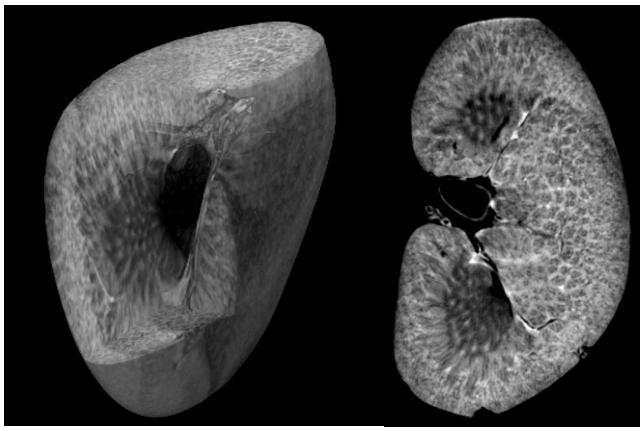

Fig.1 Phase-contrast x-ray CT of rat kidney at 35 keV.