サブテーマ名
小型高輝度X線発生装置を用いた X線位相イメージング法の開発

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Comparison of the X-ray Photon Count between 18.2 and 26.9 keV LCS X-ray mean energy Using the Rigaku HyPix3000 photon counting detector.

Figure 1. X-ray chart image using (a) 25 keV and (b) 17.5 keV LCS X-ray mean energy. Exposure time: 30 min

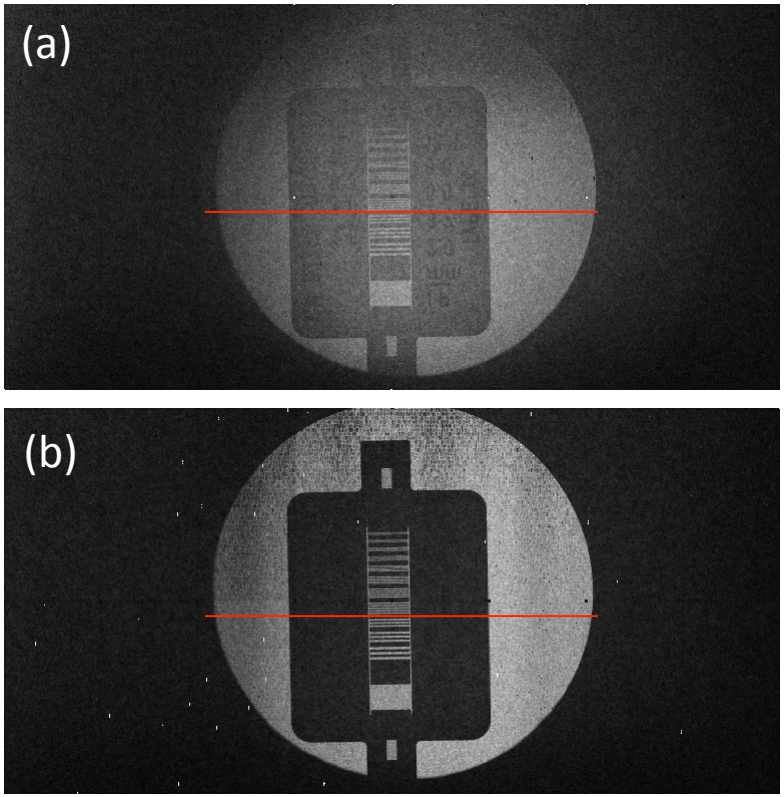
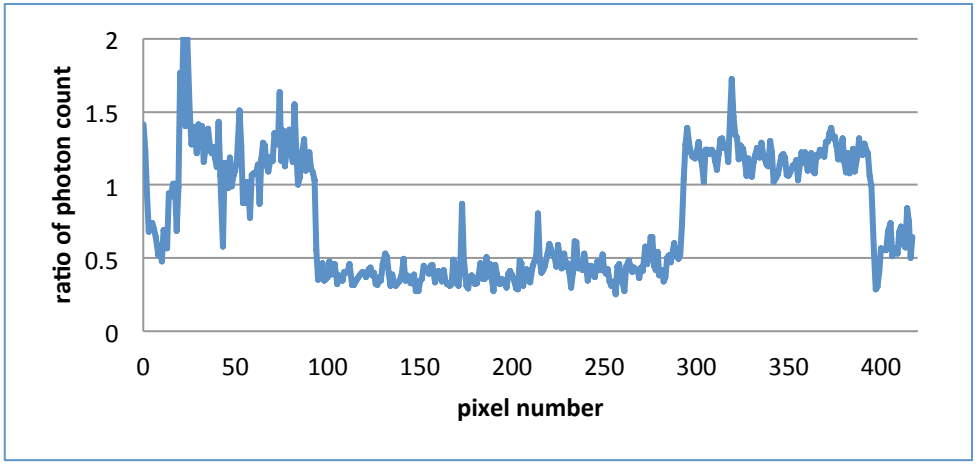


Figure 2. Plot of the Ratio of the photon counts across the line profiles in Figure 1.

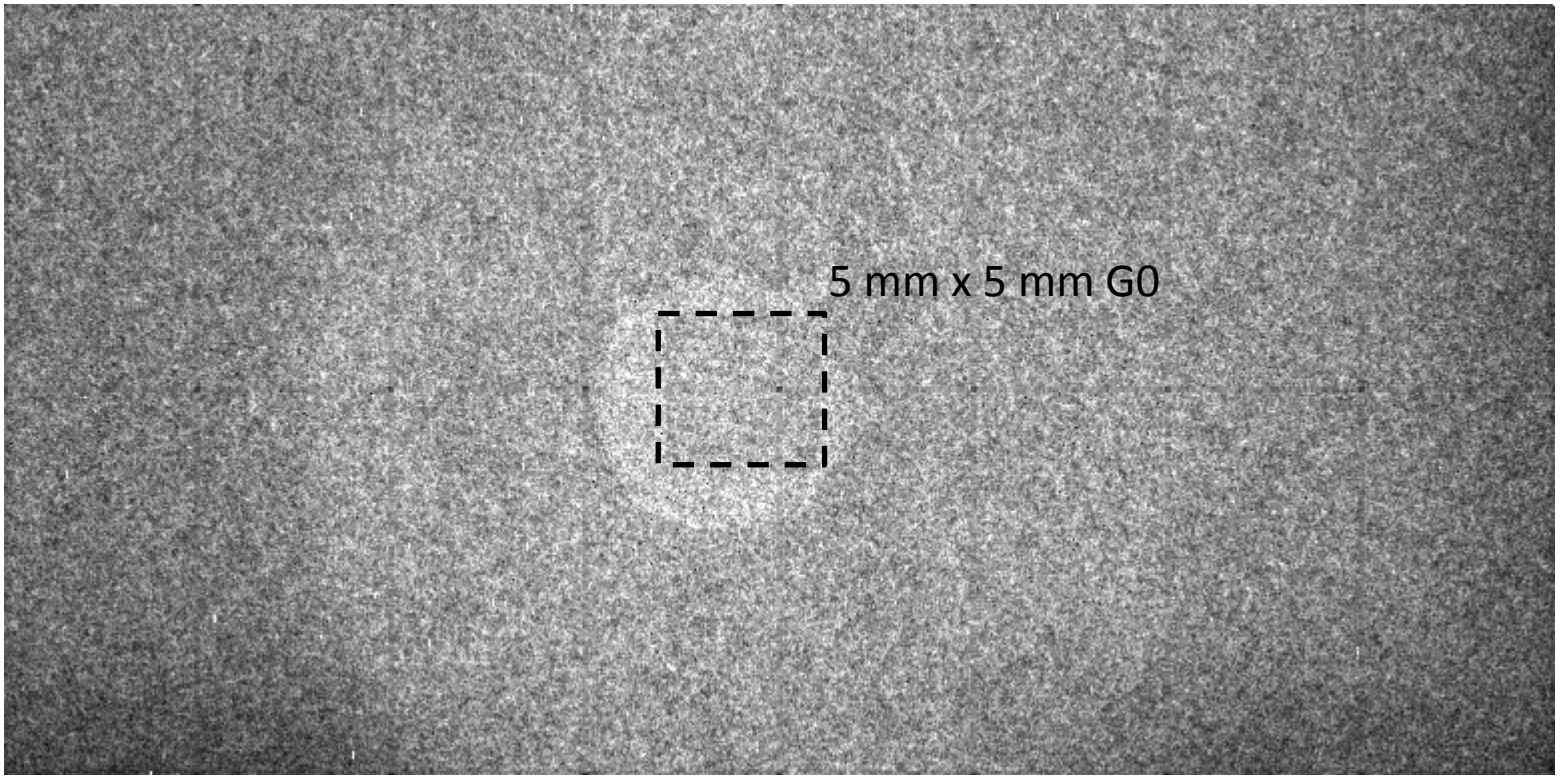
$$C\downarrow 18.2\ keV\ /C\downarrow 26.9\ keV$$



1. At regions outside the X-ray chart, the ratio of the X-ray photon count, $C\downarrow 18.2\ keV\ /C\downarrow 26.9\ keV\ \sim 1.2$ (ave).
2. At the region of the X-ray chart, the ratio of the X-ray photon count is ~0.4 (average) simply indicating that low energy X-rays are more absorbed by the Pb material of the X-ray chart.

Using LCS X-ray mean energy: 18.2 keV

- Gratings
  - G0: d0= 30um, h0= 100 um, Area= **5mm x 5mm**
  - G1: d1= 4.5um, h1= 1.8um
  - G2: d2= 5.3um, h2~ 70um
    - Si substrate thickness: 200 um (for each grating)
- R1= 963 mm
- z= 171 mm
- MOIRE WAS OBSERVED in one image before the Ti: Sapphire crystal of the laser was broken. Exposure time: 30 minutes obtained using HyPix-3000



Note on gratings' Si subtrate thickness

Although the X-ray intensity was increased when the X-ray mean energy was lower (18.2 keV in comparison with 26.9 keV), there is less transmission of the lower energy X-rays through the Si substrates of the gratings.

Within 5mm x 5mm, the X-ray energy was 14 to 18 keV. The X-ray transmission through the Silicon substrates of the 3 gratings, which is 600 um (200um x 3 substrates), was :

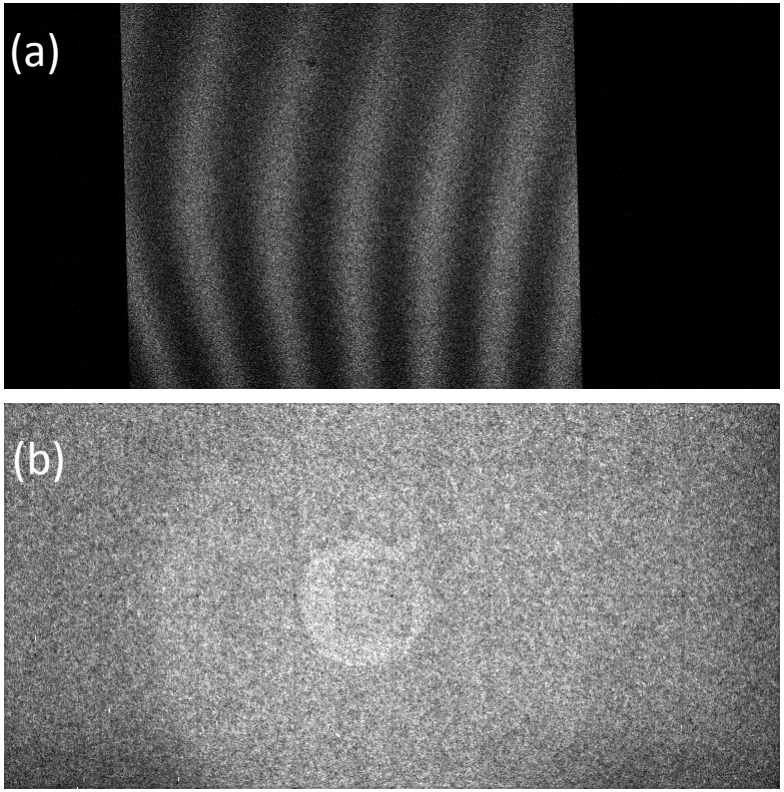
50% for 18 keV X-rays

20% for 14 keV X-rays

Thinner Si substrate should be used when lower energy X-rays are to be utilized.

Comparison of the X-ray Photon Count between a rotating anode and an LCS X-ray source Using the Rigaku HyPix3000 photon counting detector.

Figure 3. Moiré images of a Talbot-Lau interferometer using:
(a) rotating anode X-ray source (40kV tube voltage and 45mA tube current), exposure time: 10 msec (b) LCS X-ray source with mean energy 18.2 keV, exposure time: 30 min



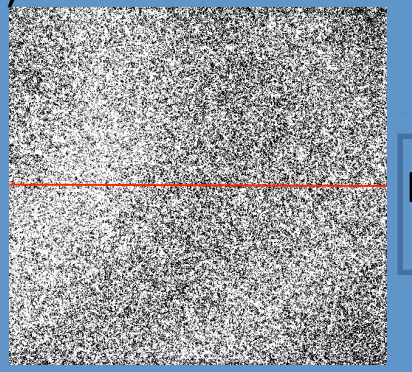
Ratio of the count rate:
$R\downarrow rotating\ anode\ /R\downarrow LCS\ X-ray\ source\ = 750/sec/0.015/sec = 50 \text{ x } 10\uparrow 3$

Comparison of the Signal to Noise Ratio between the AIST CCD-based X-ray detector and the Rigaku HyPix-3000 photon counting detector.

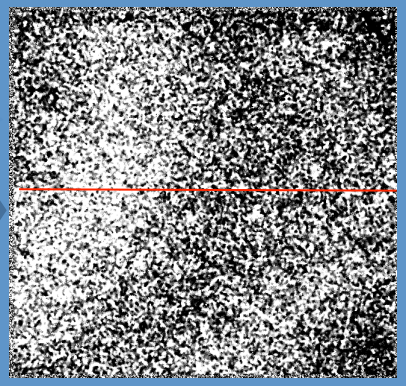
$$SNR = bright\ fringe\ (average\ intensity) / st.deviation$$

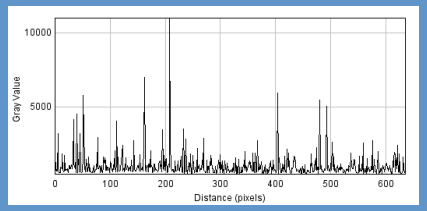
Figure 3. Moiré images of a Talbot-Lau interferometer using:
(a) AIST CCD-based detector obtained in April 2014 (X-ray mean energy: 26.9 keV), exposure time: 30 min
(b) Rigaku HyPix-3000 obtained in August 2014 (X-ray mean energy: 18.2 keV), exposure time: 30 min

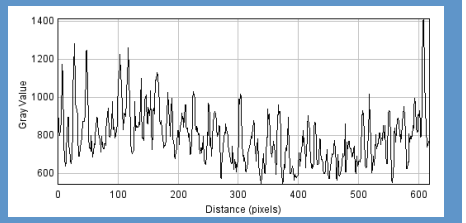
(a)



Median filter



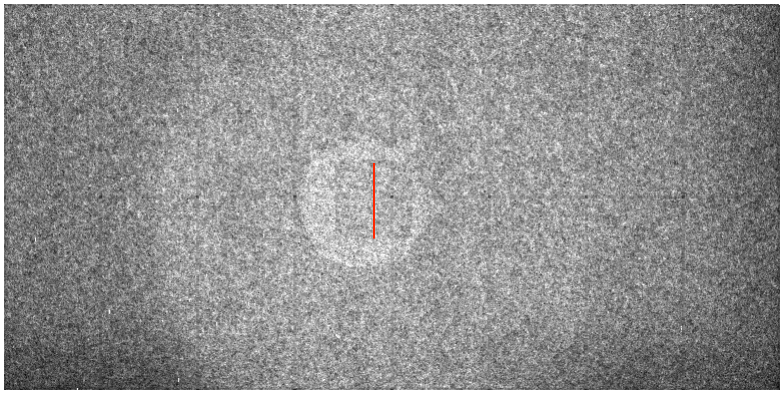


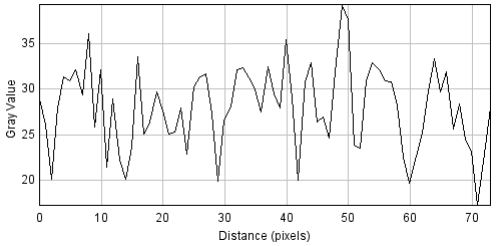


$SNR = 900/800 \sim 1.1$

$SNR = 900/140 \sim 6$

(b)



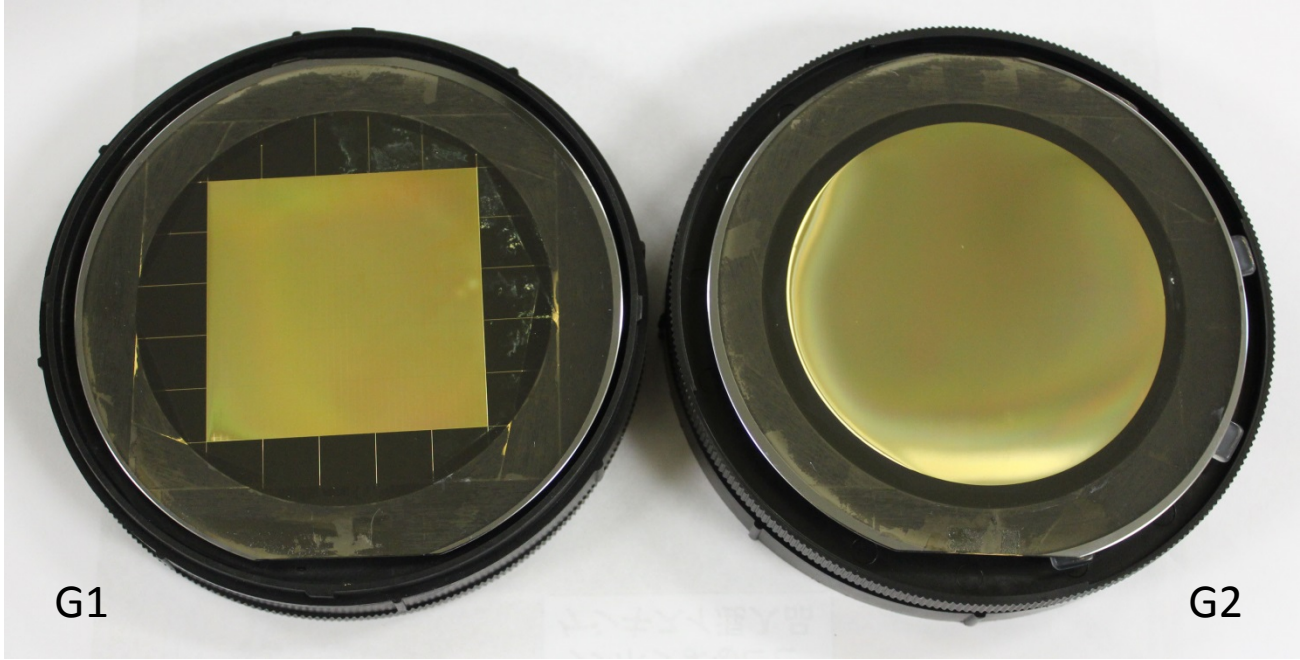


$SNR = 30/4 \sim 7.5$

X線格子

	Grating design	Grating period [μm] (Metal +Resist widths)	Grating area	Metal material	Metal thickness [μm] Absorption: -0%, +20% Phase: +/- 10%	Duty cycle = Metal/Period +/-10%
G0 (Source)	bridges	6.82 (resist width 1.84)	50 mm x 50 mm	Au	> 70	0.73
G1 (Phase)	continuous	3.57	50 mm x 50 mm	Ni	5.23 (π/2 for 30 keV)	0.50
G2 (Absorption)	bridges	7.49	d = 70 mm	Au	100	0.50

← 発注



今後の予定

- AISTにおける位相イメージング実験再実験？
  - G0納入（12月頃?）後に専用格子セットによる実験

- cERLでの実験準備
  - AIST用格子セットの流用前提
    30 keVでG0-G2間62cm。