國家同步輻射研究中心
出國報告書

出國人姓名：張櫻議、徐嘉鴻、陳俊榮、許火順、湯茂竹、賴麗珍等 15 人

出國日期：108/12/18-108/12/20

目的地：新加坡

參加會議名稱：

第十六屆亞洲結晶學會議

16TH Conference of the Asian Crystallographic Association

一、　　參加會議經過

第十六屆亞洲結晶學會議 16TH Conference of the Asian Crystallographic Association (AsCA 2019)，於十二月十七號開始在新加坡大學 Stephen Riady Centre 舉行為期四天的會議。本人於十八日出發，當天到達會場參與稍晚的議程，十九日發表海報論文，二十日返回台灣。會議議題涵蓋結晶學相關領域，主要分為三大部分: 第一為大分子與生物結構(Macromolecular Crystallography)、第二為化學結晶學(Chemical Crystallography)、第三為材料與應用(Material and Applications)，大會再將議題細分為 24 個主題(micro-symposium)，將相關的主題放在同一時段發表，讓與會者更容易選擇有興趣的議題。參與會議的學者與學生主要來自亞洲與大洋洲等 32 個國家，將近 500 位與會人員。我的壁報主題: Integrated X-ray optic chips for high-resolution, single-mode monochromator systems，分類於 Material and Applications，於十二月十九日傍晚 17:30-19:00 進行展示。

此次會議，中心的主管們也為了爭取下一屆 AsCA 2022 的主辦權而努力，在會議的 AsCA Committee Meeting 中提出規劃報告，除了台灣爭取主辦外，另外韓國代表也爭取在濟州島主辦會議。雖然最後投票結果是由韓國主辦，但看到主管們與其他國內教授學者們，齊心一致地努力爭取，爭取台灣在世界舞台展現的機會，更是鼓舞著我們，用自己的力量，讓世界更認識台灣。

二、 與會心得

我報告的題目主要是高解析度光學元件的研究，與大會的主要議題比較，算是比較偏門的主題，這次算是歷經千辛萬苦來到新加坡參加會議，有幸在壁報展示時，仍與現場的學者與學生介紹此概念，能將準備已久的報告如期發表，也算是圓滿了這次的任務。

女性學者與學生占了此會議約 34% 的人數，大會似乎很重視女性參與的比例，也特別提出此統計數字。我相當佩服能在研究路途上，持續堅持此道路的女性們，所以對此數字也相當有感觸。

三、 建議

台灣結晶學領域的研究學者蠻多的，將此類型國際會議爭取在台灣舉辦，可讓台灣的學生更有機會參與和表現，還有讓世界各國的人更認識台灣的美麗。(這次參加此會議，我更確信台灣的美好。) 有了這次爭取 AsCA 會議的經驗，建議中心未來可再規劃爭取 AsCA 主辦權。

四、　附件

✧ 壁報摘要

Abstract

SG-ASCA1040

Integrated X-ray optic chips for high-resolution, single-mode monochromator systems

[1]Ying-Yi Chang,[2]Yi-Wei Tsai,[2]Shih-Chang Weng,[3]Tai-Xing Wu,[3]Shih-Lun Chen,[3]Shih-Lin Chang

[1]Scientific Research Division, National Synchrotron Radiation Research Center, Taiwan
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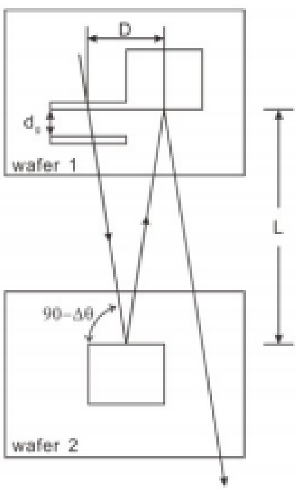
[3]Physics Department, National Tsing Hua University, Taiwan

Abstract Body:

Monochromators utilizing X-ray cavity devices for hard X-rays have been studied. Extremely high energy-resolution, of 3.45 meV, single-mode X-rays are achieved. This kind of monochromator systems for synchrotron beam lines and experiments not only enhance the energy resolution but also retain the coherence of hard X-ray sources, because of the use of Fabry-Perot type resonators as X-ray optical components.(See, Fig. 1). has been developed, which consists of a Fabry-Perot resonator and two backward-diffractive crystals; the former generates resonance fringe spectrum and the latter redirects the light path back to the incident direction and filters out the spectrum into a single mode. Moreover, the energy tunability has been implemented by using temperature controller to vary the temperature difference between the two crystal plates of back reflection. The distance between the two crystal goniometers is about 4 meters, which is a very space-consuming arrangement.

Here we propose a new idea to minimize the size of the energy tuning single-resonance-mode monochromator system into a 3 cm X 5 cm silicon wafer, forming an integrated X-ray optic chip. With the small sized chip, the monochromator can be used in synchrotron beamlines with ease. In the chip, a Fabry-Perot type resonator and two squared crystal blocks are implemented on a 3 cm X 5 cm silicon wafer using micro-nano technology. The crystal orientations are the same as the F-P resonator. The relative positions of the resonator and the two crystal blocks are to be well designed so the interference X-ray beams from the resonator could be back reflected twice into the incident beam direction. Preliminary test of the experiment showed positive results. Further adjustments and optimizations are needed.



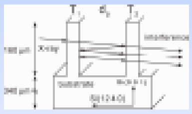
✧ 壁報展示內容

Integrated X-ray optic chips for high-resolution, single-mode monochromator systems

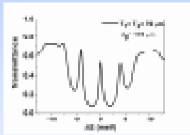
[1]Ying-Yi Chang, [1]Yi-Wei Tsai, [1]Shih-Chang Weng, [2]Tai-Xing Wu, [2]Shih-Lun Chen, [2]Shih-Lin Chang
[1] National Synchrotron Radiation Research Center, Taiwan
[2] National Tsing Hua University, Taiwan

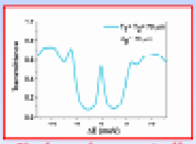
X-ray Fabry-Perot Resonator

An x-ray Fabry-Perot resonator consists of two crystal plates as reflecting mirrors. When an incident beam goes inside the resonator, it is reflected back and forth within the gap to produce resonance, thus generating interference fringes. The period of resonance fringe is related to the gap (d_g) and the extinction length. The right-hand side figure shows a single resonance peak which is used as a single-mode resonator.



E= 14.4388 KeV
Si (12 4 0) back diffraction



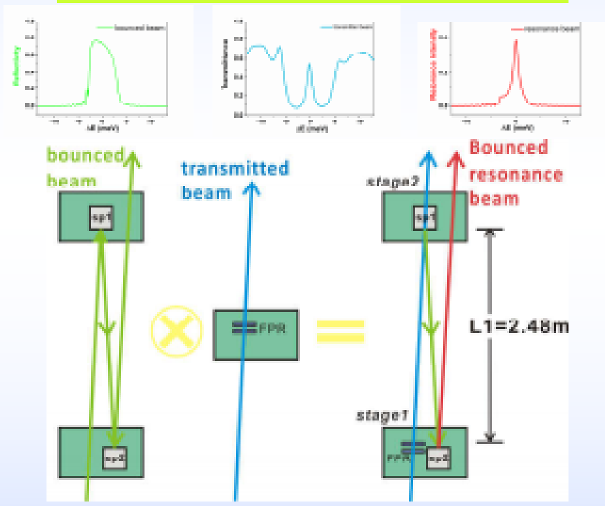


Single mode resonator!!

Single-mode monochromator system

Monochromators utilizing X-ray resonator devices for hard X-rays have been studied. Extremely high energy-resolution, of 4 meV, single-mode X-rays are achieved. This kind of monochromator systems for synchrotron beam lines and experiments not only enhance the energy resolution but also retain the coherence of hard X-ray sources. because of using Fabry-Perot type resonators as X-ray optical components. The monochromator consists of a Fabry-Perot resonator and two backward-diffractive steering crystal plates, sp1 and sp2; the former generates resonance fringe spectrum and the latter redirects the light path back to the incident direction and filters out the spectrum into a single mode. The right figure is the top view of the device. The FPR and the steering crystal plate sp2 are located in stage1 and the steering crystal plate sp1 is located in stage2. The orientation of stage1 and stage2 are respectively controlled by two goniometers. The distance L1 between the two stages is about 2.48 meters, which is a very space-consuming arrangement. Therefore, we propose a new idea to minimize the size of the single-mode monochromator system.

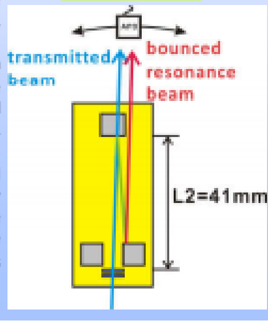
Top view and simulation of the system



Minimize the system in one chip

Here is a new design for minimizing the size of the monochromator system into a 3 cm X 5 cm silicon wafer, forming an integrated X-ray optic chip. With the small sized chip, the monochromator can be used in synchrotron beamlines with ease. In the chip, a Fabry-Perot type resonator and two squared crystal blocks are implemented on a 3 cm X 5 cm silicon wafer using micro-nano technology. The crystal orientations are the same as the F-P resonator. The relative positions of the resonator and the two crystal blocks are to be well designed so the interference X-ray beams from the resonator could be back reflected twice into the incident beam direction. Preliminary test of the experiment showed positive results. Further adjustments and optimizations are needed.

Top view



experimental data