國立交通大學
National Chiao Tung University

出國報告（出國類別： ■ A類、考察訪問
□ B類、出國短期研究
□ C類國際會議）

題目：3月3日～3月7日至東京大學訪問濱口宏夫教授實驗室

服務機關：應化系
姓名職稱：重藤真介 助理教授
前往國家：日本 東京 東京大學
出國期間：100/03/03~03/07
報告日期：100/03/10

撰寫人	審核人	初閱	複閱
重藤真介		應化系主任 100.3.15 王念夏(丙)	教務長暨頂尖大學計畫辦公室執行長 黃志彬

備註：出國報告書審核程序如下
一、初閱：各學院教師A、B、C類及其他行政單位A類由單位主管，研究生由指導教授；中心計畫及學群A、B、C類由各中心計畫主持人。
二、複閱：經費所屬之一級單位；中心計畫及學群A、B、C類由頂尖計畫執行長。

一、摘要（200-300 字）

In this trip, I visited the Hamaguchi group at the University of Tokyo (UT). The primary objective was to discuss with Professor Hamaguchi the transfer of a Raman microspectroscopic apparatus from UT to NCTU, as well as recent research progress in our laboratory at NCTU including Raman studies of single living yeast cells and bacterial biofilms. I confirmed that the conditions of the Raman apparatus are quite good, and that it should be able to work as soon as it is rebuilt at NCTU. We also discussed the research plan after the first term of the 5-500 project ends this March.

三、本文

（一）目的

The purpose of the visit is (1) to discuss with Professor Hamaguchi the research plan after the first term of the 5-500 project ends this March and (2) to examine the Raman microspectroscopic apparatus in the Hamaguchi laboratory that we are planning to transfer from the University of Tokyo (UT) to NCTU soon.

（二）過程

The schedule of my visit is summarized as follows:

3/3	14:00	Arrival at Tokyo (Narita)
3/4	11:00–12:00	Discussion with Prof. Hamaguchi and with a Ph. D. student from Canada
	12:00–14:00	Luncheon discussion
	14:00–16:00	Discussion and lab visit
3/7	10:00–12:30	Attend group meeting
	12:30–13:30	Attend staff meeting
	13:30–14:00	Discussion with Prof. Hamaguchi
	14:30–15:00	Lab visit
	18:45	Leave for Tokyo

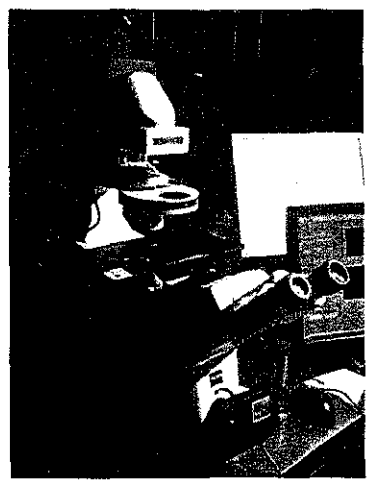
March 4. I first talked with an analytical chemistry major Ph. D. student from Université de Montréal, who is interested in working as a postdoctoral researcher in my group after graduation next year. She has been staying at UT for a few months with support of the GCOE (Global Center of Excellence) program in Japan. Then, during lunch I had a scientific discussion with Professor Hamaguchi and his Ph. D. student, Onogi. We have been involved in the project where the molecular origin of the mitochondrial Raman band at 1602 cm^{-1} (the "Raman spectroscopic signature of life") is studied. In my group, a Ph. D. student, Chuan-Keng Huang, has been investigating the effect on Raman spectra, of exogenous addition of CoQ_{10}, a strong candidate for the compounds that give the 1602 cm^{-1} band. In the luncheon discussion, I heard that, very recently, ergosterol was emerging as another possible compound. This hypothesis seems to be consistent with a biological estimation of the amount of ergosterol in yeast cells. We discussed whether this ergosterol hypothesis can account for all the other experimental observations that have been accumulated

both at UT and NCTU over the past few years. The origin of the 1602 cm^{-1} band influences more or less the ongoing projects in my group, and the discussion was really fruitful. After lunch, I continued a discussion with Professor Hamaguchi. In particular, we talked about our project report, which is due on March 18.

March 7. In the morning, I attended the weekly group meeting and subsequently monthly staff meeting. In the group meeting, four graduate students reported their research progress. Among them, the reports given by Onogi and Kakita were interesting to me because their studies are closely related to ours. Onogi showed photobleaching dynamics of the 1602 cm^{-1} band in "petite" mutants of budding yeast. The decay of the band is fitted well with a single exponential function plus an offset, and the time constant is about 70 s. Kakita reported on a quantitative analysis of the relative amount of the reduced and oxidized forms of cytochrome b/c in animal cells.

After the staff meeting, I explained to Professor Hamaguchi our recent finding that aggregates of polystyrene in the micrometer scale are detected in *Escherichia coli* biofilms. We both agreed that, given the potential impact of this novel finding not only on chemistry but also on biology, more experiments need to be performed in order to check reproducibility under various experimental conditions. Additionally, we discussed mapping results of a dividing single living yeast cell recently obtained by Chuan-Keng Huang.

Lastly I visited the lab and examined the Raman microspectroscopic apparatus that we are planning to transfer from UT to NCTU. As seen from the picture, it uses a Carl Zeiss inverted microscope. It also includes a He-Ne laser, spectrometer, and CCD detector. I will replace the He-Ne laser by the multiline Ar/Kr-ion laser that we purchased last year so that different excitation wavelengths can be used.



（三）心得及建議

All the discussions that I had during this visit are of great help for ongoing research in my laboratory; especially, the new twist to the 1602 cm^{-1} controversy (i.e., ergosterol vs. CoQ_{10}) is very important to me. It was beneficial to directly check the conditions of the Raman microspectrometer in the Hamaguchi lab, allowing me to get a better idea of what experiments would be done at NCTU after transfer. I hope that having this apparatus at NCTU will

greatly enhance our Raman study. As always, I highly appreciate kind support from the ATU plan.

一、摘要（200-300 字）

在這次出訪行程中，我拜訪東京大學裡的濱口宏夫教授實驗室。最主要的目的是討論搬運拉曼成像系統至交大一事，同時也討論目前實驗室的研究進程，包括使用拉曼光譜術研究單一活體酵母菌及細菌生物膜。我測試這套拉曼系統，此系統狀況良好，我們相信設置在交大實驗室之後，此系統亦能呈現良好的功能。同時，我和濱口教授也討論在第一期五年五百億計畫結束後，我們實驗室的研究計畫。

三、本文

（一）目的

這次的出訪目的如下：

（1）和濱口宏夫教授討論第一期五年五百億計畫在三月結束之後，實驗室的研究計畫。

（2）檢驗預計從濱口宏夫教授實驗室搬遷至交大的拉曼光譜系統。

（二）過程

出訪過程簡列如下：

3/3	14:00	抵達東京成田機場
3/4	11:00–12:00	和濱口宏夫教授及加拿大籍博班生討論
	12:00–14:00	午餐會報
	14:00–16:00	討論及參訪實驗室
3/7	10:00–12:30	參與團體報告
	12:30–13:30	參與實驗人員團體報告
	13:30–14:00	和濱口宏夫教授討論
	14:30–15:00	參訪實驗室
	18:45	離開東京

3 月 4 日

首先和加拿大蒙特婁大學主修分析化學的博班學生討論，她對畢業之後進至我們的團隊擔任博士後研究員一事感興趣。她得到 GCOE (Global Center of Excellence) 資助已在東京大學進修了幾個月。於午餐時間，我和濱口宏夫教授及實驗室學生小野木同學討論。我們曾在計畫中研究到粒腺體拉曼譜線的分子在 1602 cm^{-1} (the "Raman spectroscopic signature of life")。在我們的團隊裡，博班學生黃傳耿已檢驗出拉曼光譜的成果，在輔酵素 Q10（CoQ_{10}）外源性條件中，其可能產生 1602 cm^{-1} 的射線。在午餐會報中，我聽說近期麥角固醇可整合成爲另一項可能的化合

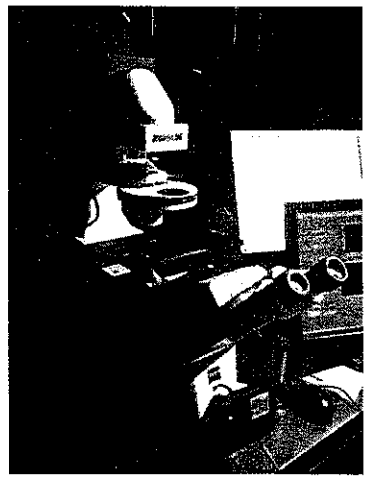
物。此項假說似乎符合酵母細胞中生物估算上的麥角固醇量。我們討論是否此麥角固醇假說能視爲這幾年在東大和交大間所有實驗的觀測結果的累積。1602 cm^{-1} 射線起源的影響爲本實驗室進行的計畫，且此項討論非常有收穫。在午餐之後，我繼續和濱口宏夫教授討論 3 月 18 日到期的計畫報告。

3 月 7 日

早上我參加一星期一次的團體會議，隨後參加一個月舉辦一次的成員會議。在團體會議中，4 位研究生報告他們的實驗進度。在這些報告中，學生 Onogi 君和 Kakita 君的報告使我感興趣，因爲他們的領域和我們的範圍相似。Onogi 君呈現芽殖酵母中小菌落突變體中的 1602 cm^{-1} 的射線光致漂白效應動態力學。此射線的衰變指數在誤差之下仍符合單一指數函數，且時間常數約爲 70 秒。Kakita 君以量化分析的方式報告動物細胞中細胞色素定量 b/c 簡化及氧化的相對比例。

在成員會議之後，我向濱口教授解釋我們最近的發現：在測微量尺中的苯乙烯中的集群能大腸桿菌的生物薄膜中檢測出。我們彼此也同意，這項新穎的發現能對化學界和生物界產生潛在的衝擊，爲此，我們需要在不同的實驗環境中再次檢驗。除此之外，我們也討論由黃傳耿同學最近取得的分裂活體單一酵母菌的映射成果。

最後，我拜訪實驗室，並檢驗這套預計從東京大學搬運至交通大學的拉曼顯微成像系統。如右圖所示，它使用卡爾・蔡司公司的倒轉顯微鏡。同時也包含氦氖雷射、光譜儀、及電荷藕合元件偵測器及控制器。我將會將氦氖雷射替換爲去年購買的氪氬離子雷射，那麼將可使用不同的雷射激發波長。



（三）心得及建議

在這次出訪中進行的討論，預計對未來將進行的計畫有很大的助益，特別是扭轉對 1602 cm^{-1} 爭議（麥角固醇和輔酵素 Q10），對我們而言是重要的。能親自至濱口教授實驗室檢驗拉曼顯微系統對我們而言是有益的，也希望在儀器搬運至交大之後，能得到實驗室更好的靈感。我希望在交大擁有這套系統能大大提升拉曼研究。同時，我們感謝「邁向頂尖大學計畫」的支持。