

# 行政院國家科學委員會專題研究計畫 期中進度報告

核心設施：台灣聯合大學系統奈米製作暨分析核心設施中心  
(2/3)

計畫類別：整合型計畫

計畫編號：NSC93-2120-M-009-005-

執行期間：93年08月01日至94年07月31日

執行單位：國立交通大學電子工程學系暨電子研究所

計畫主持人：李建平

共同主持人：徐子民，韋光華，林登松

報告類型：精簡報告

處理方式：本計畫可公開查詢

中 華 民 國 94 年 6 月 9 日

**Core facility for nanofabrication and nano characterization of  
The University System of Taiwan (UST)**

**台灣聯合大學系統奈米製作與分析核心設施中心**

2004/08/01 ~ 2005/05/31

PI : Chien-Ping Lee(李建平), National Chiao Tung University, cplee@mail.nctu.edu.tw

Co-PI : K.H. Wei(韋光華)、D.S. Lin(林登松)、T.M. Hsu(徐子民)

The NSC sponsored “Core Facility for Nano-fabrication and Nano-characterization” program was formally kicked off on Aug 1<sup>st</sup> 2003. With a total funding of 120M NT over a period of three years, this core facility has the mission of establishing a world class laboratory with the state of the art instruments for nano-fabrication and nano-characterization. Entering the second year, the program has been moving forward with full thrust. We have completed the purchase and the installation of most of the instruments planned for the first two years. Both NCTU and NCU have provided generous matching fund and the support on the lab space, personnel management and other software support.

**Hardware and operation of the core facility**

All the instruments for the first two years have been purchased and delivered. The following table lists the cost of each equipment, the NSC’s budget and the matching fund provided by the university. For the NCTUs’ part, all the equipments except the low temperature and high magnetic field system have been installed and in operation.

年度	設備名稱	經費			位置	現況
		總價	國科會	配合款		
92	低溫強磁場系統 Low Temperature / High Magnetic Field System	9,656,460	47,000,000	19,034,460	交大	Lab under preparation, will be in installed in the summer 2005
	兩台高分辨穿透式電子顯微鏡 (半導體, 有機材料) High-resolution transmission electron microscope	56,378,000			交大	In service since 5/1/2005
93	分子束磊晶系統 Veeco Gen II (MBE)	23,000,000	31,000,000	1,600,000	交大	In operation since 4/1/2005
	專用於三五化合物半導體元件之化學離子反應式深度蝕刻機 ICP-RIE System of III-V Compound Device Production	9,600,000			交大	In service since 4/1/2005
	場發射掃瞄式電子顯微鏡* Field Emission Scanning Electron Microscope	(7,500,000)			中央	
94	銻化物分子束磊晶系統 Sb based molecular beam epitaxy	(30,000,000)	26,000,000	(4,000,000)	中央	

The status of each instrument is described in the following

1. MBE system:

## MBE system (Veeco GEN II) (class A)

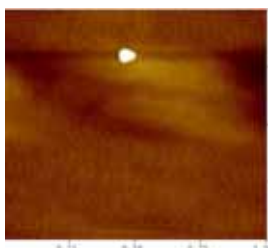


The new system is connected with one of our old MBE systems. **It is in operation since April 2005.**

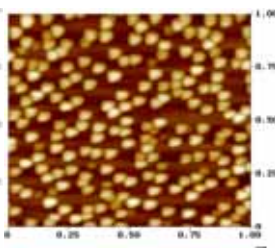
Another system in Po-Si campus has been refurbished and will be used for Sb and N compounds.

**Combined capability:**

As-based, P-based and Sb-based semiconductor nanostructures, including InAs/GaAs, InP/InGaAsP Quantum dots  
 InAs/InGaAs/InP quantum wires  
 InAs/GaAs, InAs/InP quantum rings  
 InP-based photonic crystal devices  
 A diversity of GaSb-based nanostructures: type I, type II and "W" type quantum wells, which find applications in telecommunication and molecular spectroscopy.  
 GaSb/GaAs quantum dot  
 Dilute nitride semiconductor materials  
 GaInNAs and GaInNAsSb grown on GaAs substrate provide excellent candidates for a variety of lower cost 1.2–1.6  $\mu\text{m}$  lasers, optical amplifiers and high power Raman pump lasers



Extremely low density QDs



regular QDs

## 2. High resolution TEM systems

### High resolution TEMs (class B+)



JEM-2100F

With the additional support from NCTU, we have purchased **two HRTEMs**. The availability of the systems makes possible to satisfy most of the sample requirements for nano research.

**JEOL, JEM-2100F**

EELS, EDS

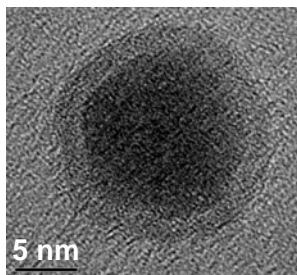
In final stage of tuning, will be in service in a month.

**JEOL, JEM-2010**

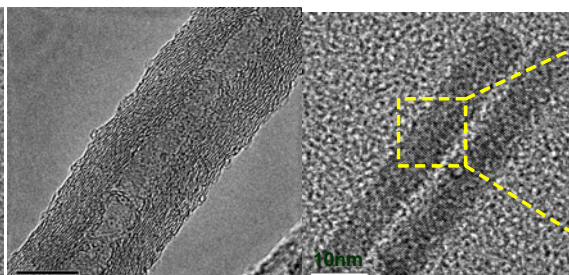
EDS Gatan Cryo-Transfer Specimen Holder

In service and operator training since May 1st 2005.

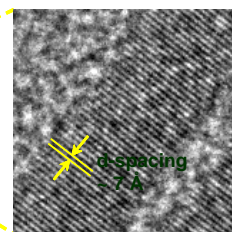
Four week TEM training course is currently underway.



The shell thickness of the 18.5nm Fe/Fe<sub>x</sub>O<sub>y</sub> core-shell nanoparticle is 2.5nm.



Layered structure of bamboo like CNT



CdSe nanorods with lattice spacing  $\sim 7\text{\AA}$  in c-axis

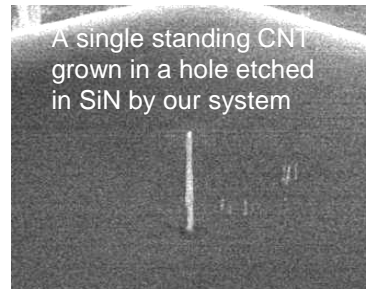
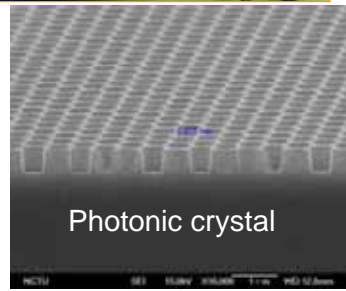
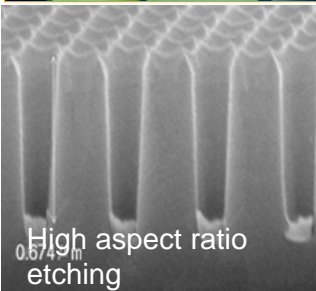
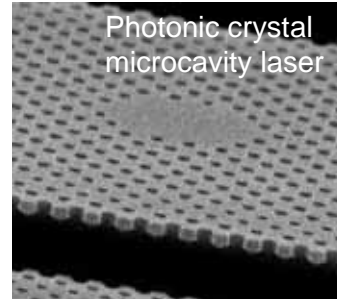
## 3. ICP-RIE system

**ICP-RIE for nanofabrication (Oxford, plasmalab system 100, class B)**



Excellent etched profiles for photonic crystal fabrication.

In service since April 2005.



**4. Low temperature high magnetic field measurement system**

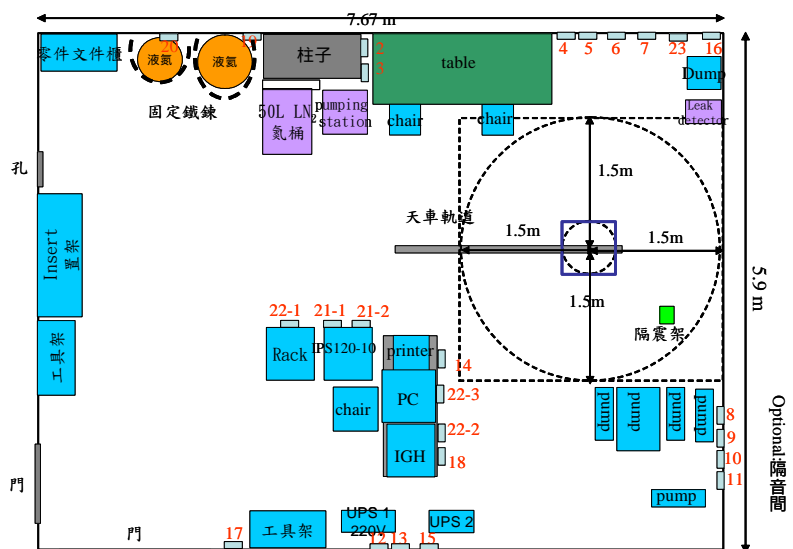
We have reached an agreement with the National Nano Device Laboratory to set up a low temperature laboratory for nano research in the new NDL building. Our low temperature high magnetic field system will be placed in this lab. The detailed design of the lab has been completed and is currently under final review. We expect to move into the new lab in the summer.

**Low temperature measurement lab in new NDL building**

1. Low temp high mag measurement system
2. THz and optical measurement system



Base temperature 25mK  
Magnetic Field: 16T



Lab preparation underway

## 5. Other instruments purchased under the support of NCTU

Besides the equipment purchased using the NSC's fund, some other instruments purchased under other funding sources have also been included and put under the control of the facility. These instruments include: (1) an SEM converted E-beam writer, (2) three AFMs, (3) a high vacuum SPM, (4) an XRD, (5) a mask aligner. All of them are currently in operation and provide valuable services to the researches in nanotechnology. They are open to all researchers with projects in nanosciences.

### Management of the core facility

We have set up a membership system for each of the center's instruments. By paying a membership fee, the user can get a fixed number of machine time. When applying for membership, the user is required to provide a NSC's account number. If the application is approved, the membership fee will be automatically transferred to our center's account. The member has the right to be trained as an operator of the instrument he wants to use. In this way, we establish a long term partnership with each user. Currently we have a total of 34 members. We also provide paid service for those who do not want to be members and those who are in industry. The response from the users for our system has been very positive. The usage of each machine in service for the period from 9/2004 to 3/2005 is listed in the following.:

## 奈米核心設施實驗室

### 核心設施中心設備使用統計：93年9月至94年3月

設備名稱	委託操作時數 (小時)/人次	自行操作時 數(小時)/人 次	總時數(小時)/ 人次
E-Beam Lithography System	156/68	487.4/189	643/257
Atomic Force Microscope	17.5/7	312.7/92	330.2/99
High Resolution X-Ray Diffractometer	112.5/43	209.5/53	322/96
Deep UV Mask Aligner	7/4	67.08/37	74.08/41

It should be mentioned that our users come from many different universities and research organization. For example we have users from NCKU in Tainan and NTU in Taipei as well as people from ITRI. The new equipment put in service recently does not have enough usage data yet. The statistics will be added as time goes by.

All the rules, the fees and the information of each instrument are clearly described in our center's website. The users can download the application forms. Once we receive an application, we will respond within 4 days. We believe effective management is one of the keys for the success of our center. The following items are clearly listed in the website.

### 在網頁上可以找到每項設備的

- 一、儀器名稱
- 二、儀器廠牌、型號及儀器購置年份
- 三、放置地點
- 四、服務項目
- 五、設備重要規格
- 六、設施服務須知
- 七、對外開放服務時間與預約時段
- 八、服務申請流程
- 九、一般收費標準



The web page of our center was designed to be very user friendly. Anybody can very easily find the information he needs in terms of using the center's facility.

**Nano CENTER** 國立交通大學奈米科技中心 Center for Nano Science & Technology

回到首頁 交通大學首頁

歡迎光臨交通大學奈米科技中心！ [上次更新日期為 2005年5月12日]

**最新消息**

2005/05/12	固態電子系統大樓與國家奈米元件實驗室門禁磁卡申請表更新 (適用於國立交通大學奈米科技中心員工暨研究生)
2005/05/10	JEOL-2010TEM 儲值卡申請表暨經費轉帳核准單更新
2005/05/06	奈米科技中心最新海報展示
2005/05/06	設備介紹 與 設備使用申請表更新
2005/05/02	設備介紹 與 設備使用申請表更新
2005/05/02	2005 奈米產業技術研討會[按右鍵下載]
2005/04/21	JEOL-2010 HRTEM管理辦法、實驗申請單與 儲值卡申請表
2005/04/21	教育部2005年奈米創意專題成果競賽辦法[按右鍵下載]
2005/04/18	設備使用申請表更新【增加ICP使用申請表】

#### Conclusion:

With the support of NSC, NCTU and NCU we have set up a core facility for nano-fabrication and nano-characterization. The facility is in operation and open to researchers in nanoscience and technology. A management system has been set up for the operation of this facility. From the response of the users and the statistics of the machine usage, our management and the operation of the facility have been very successful. We believe that we have a model that can make us achieve the following goals:

- First class research facility that can accommodate researchers from different disciplines in nanoscience.
- A service center with technical expertise that can help people to do first class research.
- A platform for collaborative research.
- A research center that science takes priority over everything else.