

**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**

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The NSC sponsored "Core Facility for Nano-fabrication and Nano-characterization" in UST was formally kicked off on Aug 1st 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. While the NSC's fund is primarily used for equipment purchasing, the lab space, personnel management and other software support are provided by UST (in this case mostly NCTU and NCU).

Management of the core facility

A management team was formed to oversee the day to day operation of the core facility. This team is a sub group of the management organization of UST's nano center. Besides the PI and the co-PIs, 8 professors who are active participants of the nano research programs were invited to be the members of a management committee. Under the direction of the committee, a set of lab rules were set up for the use of the facility. Besides the students and researchers, the facility currently has five full time employees: an administrative secretary, two post docs and two technicians.

Each piece of equipment in the core facility has a small operation team consisting of a professor, a post doc, a technician and a graduate student. This team is responsible for the maintenance, operation and service scheduling of the equipment.

Hardware and operation of the core facility

The 40M NT dollars approved for this year was used for purchasing (1) a low temperature, high magnetic measurement system, and (2) two high resolution TEMs. Since the fund allocated was not enough, a matching fund of 19,034,460 NT was provided by NCTU and UST. After a long process of evaluation and negotiation, these instruments have already been ordered. Since they are all major equipment, the delivery time is pretty long. The low temperature system is scheduled to be delivered in August and the TEMs are scheduled to be installed at the end of this year. A brief description of these instruments is given in the following:

(1) Low temperature, high magnetic field measurement system

Model: Oxford Instruments, Kelvinox MX40

Capability: base temperature 20mK, cooling power 40 μ W at 100mK, 16 T at 2.2K, 14 T at 4.2K

(2) Field Emission TEM

Model: JOEL JEM-2100F

1. Resolution: point resolution ≤ 0.23 nm, lattice resolution ≤ 0.1 nm

2. Accelerating Voltage: (A) range: 200KV (B) stability: ≤ 2 PPM/min

3. Electron Gun: (A) emission type: ZrO/W (100) Schottky type (B) brightness: 4×10^8 A/cm² . Str (C) high current in probe (0.5nA or more in 1nm probe) (D) vacuum pressure: 3×10^{-8} Pa or better

(3) Filament type TEM

Model: JOEL JEM-2010

1. Resolution: point resolution ≤ 0.23 nm, lattice resolution ≤ 0.14 nm

2. Accelerating Voltage: (A) range: 200KV (B) stability: ≤ 2 PPM/min

3. Electron Gun: (A) acceleration: six stages (B) acceleration voltage: 80, 100, 120, 160, 200KV (C) bias: self-bias, continuously variable (D) airlock and gun lift: automatic (E) filament: precentered single crystal LaB6 cathode



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) two 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.

由國科會所資助的台灣聯合大學『奈米製程與分析核心設施』正式於民國 92 年 8 月 1 日啟動。本核心設施的目標為建立一世界級的奈米製程與分析實驗室，由國科會所資助的一億二千萬與台灣聯合大學所提供的配合款與硬體設備，購置精密實驗設備，提供台灣聯合大學成員及新竹地區第一流的奈米實驗場所與奈米製程及分析服務。

核心設施的管理

本核心實施隸屬於台灣聯合大學奈米中心，由交大之奈米科技中心負責。核心設施管理委員會，除計畫主持人與共同主持人外，成員包括八位參與此奈米研究的教授組成。此管理委員會訂定實驗室與每一項設備之管理使用辦法。目前此辦法已公佈於交大奈米科技中心之網站。目前本中心聘有五位全職人員。包括一行政助理，二位博士後研究員與二位技術員。在本核心設施下之每一項設備均配有一儀器管理操作小組，包括一位教授，一位博士後研究員，一位博士生與一位技術員。由他們負責該項設備之維護，操作與服務之安排。

核心設施之儀器與儀器工作狀況

國科會今年所核發的四千萬費用我們購置了(一)低溫高磁場量測設備，(二)二台高解析度穿透式電子顯微鏡(一為場發射型，一為燈絲型)由於設備昂貴，交通大學與台灣聯大提撥了 19,034,460 元做為購置的配合款。經過長時間的評估作業，目前此三項設備均已完成採購程序。低溫系統預計今年暑假可以交貨。TEM 則預計於年底時裝機。現將所購買三項設備的功能簡述於後：

(1) 低溫高磁場量測系統

型號：Oxford Instruments, Kelvinox MX40
功能：base temperature 20mK, cooling power 40 μ w at 100mK
磁場：16T at 2.2K, 14T at 4.2K

(2) 場發射型穿透式電子顯微鏡

型號：JOEL, JEM-2100F
解析度：point resolution 0.23nm, lattice resolution 0.1nm
加速電壓：200KV, stability 2ppm/min
電子槍：ZrO/W Schottky type, Brightness: 4×10^9 A/cm². Str

(3) 燈絲型穿遂式電子顯微鏡

型號：JOEL, JEM-2010
解析度：point resolution 0.23nm, lattice resolution 0.14nm
加速電壓：200KV, stability 2ppm/min
電子槍：6 級加速, single crystal LaB6 cathod.

除上述今年購買的設備外，其它由交大過去兩年購置的奈米製程及分析設備亦已納入本核心設施實驗室，由本中心統一管理。這些設備包括：(1) 一台由 SEM 改裝的 E-beam writer, (2) 二台 AFM, (3) 高真空 SPM, (4) 一高解析度 XRD, (5) 一光學微影機。這些設備目前均運轉正常並對外開放，提供奈米研究同仁使用。

Conclusion:

With the support of NSC, NCTU and UST, we have set up a core facility for nano-fabrication and nano-characterization. The facility is in operation with five pieces of equipment running providing services for various research projects related to nanoscience and technology. The new equipment purchased with the first year's fund from NSC will be in service later this year or early next year.

結論

在國科會，交通大學及台灣聯合大學系統的資助下我們成功的建立了『奈米製程及分析核心實驗室』。本實驗室已開始運作並提供了奈米研究工作者寶貴的服務。今年在國科會資助下所購置的設備預計將在年底或明年初加入服務。