

上海・蘇州の研究所

兵庫県立大学
高度産業科学技術研究所
極端紫外線リソグラフィ研究開発センター
渡邊健夫

第3回日中電子材料シンポジウム訪中団の日程(その1)

9月9日(月)

- 9:00~16:00 上海 研究会 中国科学院上海微系統と情報技術研究所
- 16:00~17:00 Showroom見学
- 19:00~21:00 懇親会

9月10日(火)

- 9:30 上海同期放射光源 (益先生途中下車帰国14:05浦東発)
- 14:00 海尼赛拉传感器有限公司
- 16:00発 高速道 貸切車で蘇州工業園区に移動

9月11日(水)

- 9:30~12:00 中科院蘇州ナノ研究所
- 12:00~13:15 昼食懇親会
- 13:30 無錫へ移動
- 14:30~15:30 東京大学無錫代表所
- 15:30~16:00 無錫駅へ移動
- 16:30 無錫発 G20高速動車 21:09北京南着

9月14日(土)

- 9:00-12:00 北京理工大学 でEUVL技術に関する講義
- 12:00-13:00 昼食懇親会
- 18:00-20:00 懇親会

第3回日中電子材料シンポジウム訪中団の日程(その2)

9月12日(木)

- 8:50~15:00 北京研究会 於中国科学院微電子研究所
- 15:00~17:00 中国科学院微電子研究所 集積回路先導工芸研開中心 見学
- 17:00~18:00 質疑
- 18:00~ 懇親会

9月13日(金)

- 8:30~11:20 清華大学微電子系 王志華教授(Wang Zhihua)
- 11:30~12:50 昼食 (後藤様 午後帰国 空港15:45発)
- 13:30~15:30 清華大学材料と工序系 李敬鋒教授(Li Jingfeng)
- 18:00~20:00 懇親会



上海シンポジウム参加者

1人あたり20分程度の講演

講演者： 山口(JSR)、後藤(Fuji Film)、
水野(Toppan)、渡辺(Toppan)、上杉(旭化成)、
益(東北大)、渡邊(兵庫県立大)、韓(NIMS)

山岡(団長、日中科学交流協会 理事)、
岡田(日中科学交流協会 理事)、
永崎(日中科学交流協会 事務局長)

敬称略 順不同



The 3rd Sino-Japan Symposium on Information and Electronic Materials 第三届中日信息及电子材料研讨会

Organizers

Chinese Academy of Sciences (CAS)
Japan-China Science and Technology Exchange Association (JCSTEA)

Management

Shanghai Institute of Microsystem and Information Technology (SIMIT), CAS
Chinese Chair: Dr. Xi Wang, Director General of SIMIT
Japanese Chair: Dr. Tuguo Yamaoka, Director of JCSTEA
Chinese Secretary General: Dr. Zhengxin Liu, SIMIT
Japanese Secretary General: Takao Nagasaki, JCSTEA
Sept. 9, 2013

Monday, Sept. 9, 2013	
	Chair: Zhen WANG
09:00-09:10	Opening speech from CAS Weiping CHEN CAS
09:10-09:20	Opening speech from JCSTEA Tsuguo Yamaoka Director of JCSTEA
09:20-09:50	Recent advances in ion beam processing commercial semiconductor materials in China Xi WANG Director general of SIMIT
09:50-10:20	Recent CMOS Miniaturization Trend Kazuyai MASU Solutions Research Laboratory, Tokyo Institute of Technology
10:20-10:35	Coffee Break
	Chair: Masatoshi Okada
10:35-10:55	In Situ Surface Characterization Using Ambient Pressure Photoelectron Spectroscopy Zhi LIU State Key Laboratory of Functional Materials for Informatics, SIMIT
10:55-11:15	DYE-SENSITIZED SOLAR CELLS Liyuan HAN Photovoltaic Materials Unit, National Institute for Materials Science,
11:15-11:35	R&D of solar cell material and devices in China and SIMIT Zhengxin LIU Research Center for New Energy Technology, SIMIT
11:35-11:50	Photo Shooting
11:50-13:00	Lunch

Recent Advances in Ion Beam Processing Commercial Semiconductor Materials in China

Xi Wang

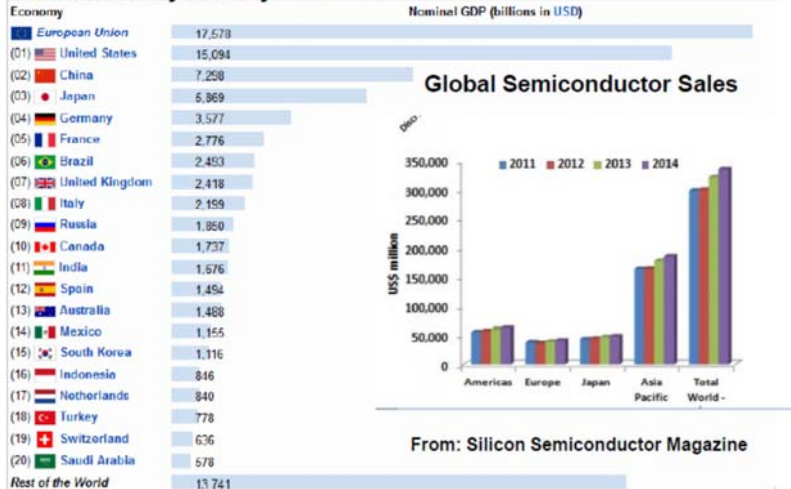
State Key Laboratory of Functional Materials for Informatics,
Shanghai Institute of Microsystem and Information Technology (SIMIT),
Chinese Academy of Sciences (CAS)

Outline

- Ion implantation is one of the enabling technologies for semiconductor industry
- Recent advances in applications of ion beam technology in semiconductor and beyond
 - Solar cell doping by B⁺ implantation
 - Simbond[®] SOI by O⁺ implantation
 - Sim-cut[®] SOI by H⁺ implantation
- Commercialization of SOI R&D
- Conclusion
- Acknowledgement

Global Semiconductor Market

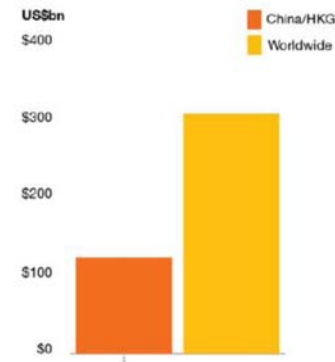
Global GDP by country Largest economies by nominal GDP, 2011



China's Semiconductor Market

China and the semiconductor industry: 2011 market overview

Total semiconductor

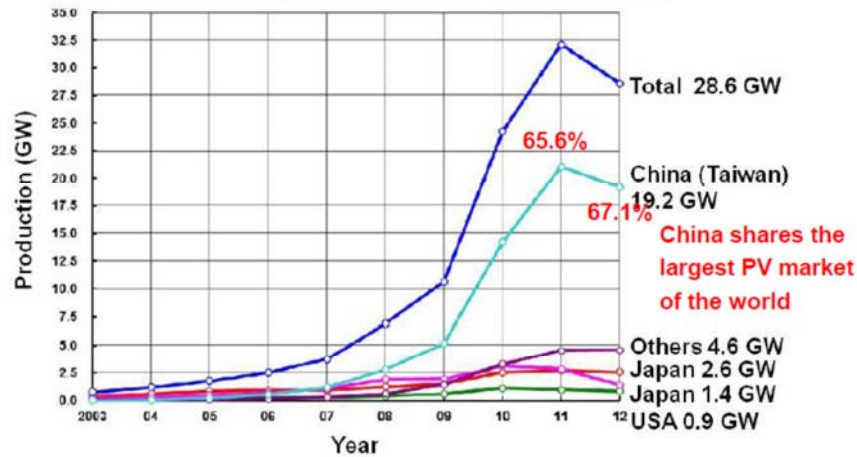


China/HKG (GDQ) \$123 billion, or 40.5% of worldwide

From: www.pwc.com

PV Industry in China

Production/shipment volume of the world



R&D of solar cell materials and devices in China and SIMIT

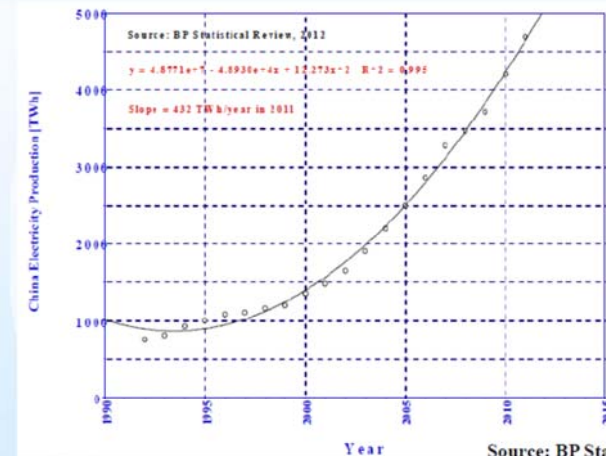
Zhengxin Liu

Research Center for New Energy Technology
SIMIT/CAS

Outline

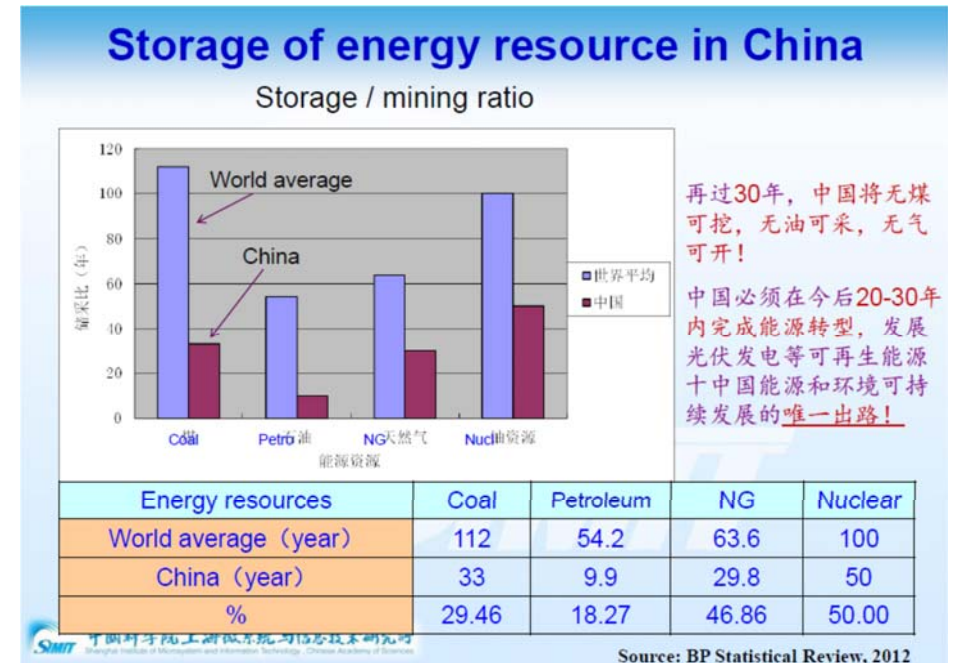
1. Energy supply and renewable energy in China
2. PV industry and R&D in China
3. R&D of solar cells in SIMIT
4. Summary

China's electricity production



Source: BP Statistical Review, 2012

Quadratically rising annual requirement!



China's choice:

Provide **432 TWh/year** increase by

82 GW coal/year (assuming C.F. = 0.6)

or

55 GW nuclear/year (assuming C.F. = 0.9)

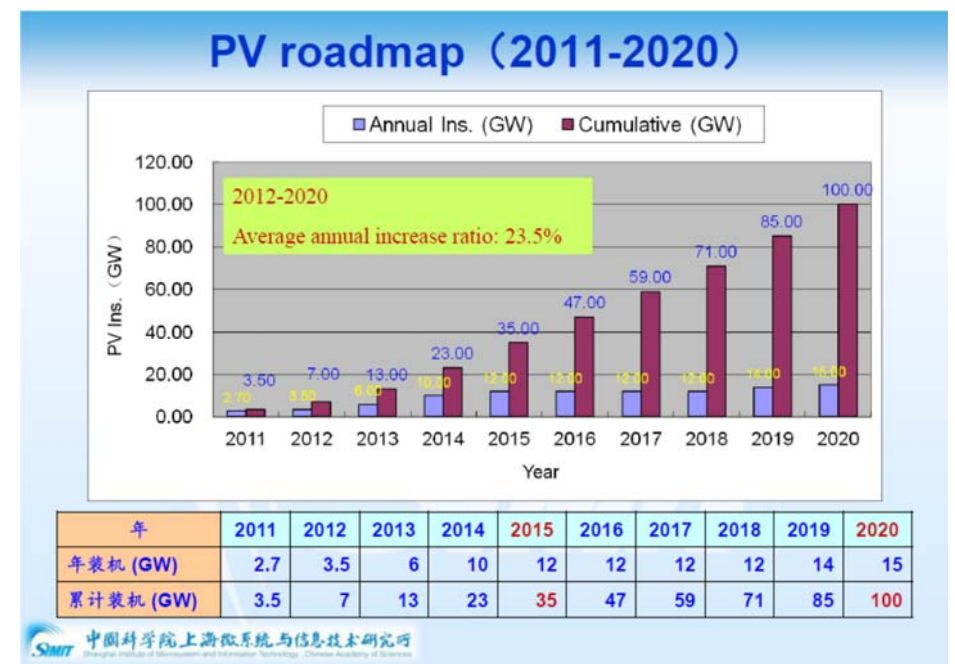
or

290 GWp PV/year (assuming C.F. = 0.17) or

197 GW wind/year (assuming C.F. = 0.25)

or some combination

中国科学院上海微系统与信息技术研究所



Comparison of solar cell efficiencies

Solar cell efficiency in lab R&D

Commercial solar cell efficiency

	World	China		World	China
Mono-Si	25.0%	20.4%	Mono-Si	22%	19.5%
Multi-Si	20.3%	19.6%	Multi-Si		18.5%
Compound 3-junction	43.6%	34.0%	Compounds 3-junction	27.5%	24.0%
CIGS	20.3%	19.1%	a-Si	8~10%	8-10%
CdTe	16.7%	15.4%	CIGS	15.7%	
DSC	14.0%		CdTe	8~10%	
HIT	24.7%	20.9% (SIMIT)	HIT	22%	20.6%

SIMIT 中国科学院上海微系统与信息技术研究所
Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

3. R&D of solar cells in SIMIT

Research Center for New Energy Technology

- 1. Solar
 - High efficiency crystalline silicon solar cell
 - CIGS thin film solar cell
 - Standardized testing
 - Solar cell system: reliability of module

- > 結晶シリコン太陽電池の高効率化
- > CIGS薄膜太陽電池技術開発
- > 太陽電池モジュールの信頼性、高効率化利用
- > 太陽電池の標準測定、評価

Energy production

Energy storage

- 2. Lithium-ion and nickel-metal hydride batteries
- 3. Hydrogen storage materials and devices

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Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

Joint research with industry

Research Center for New Energy Technology

State Key Lab of PV Science & Technology



HJ solar cell Joint-research lab

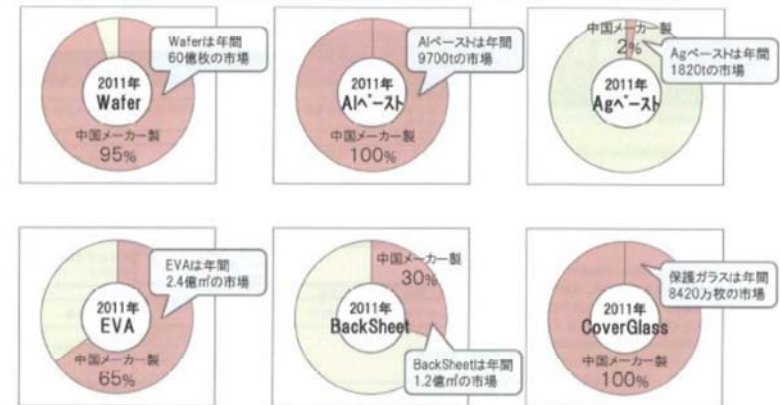
Technology transfer



SIMIT 中国科学院上海微系统与信息技术研究所
Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences

太陽電池の主要部材の国産化比率

◆ セル工程とモジュール工程での主要部材は、中国メーカーによる国産化が進む。



※試算結果
中国の2011年の太陽電池モジュール生産量は16GW -モジュール1枚につき、出力は190W、セルは72枚使用とした

出典：ヒアリング情報をもとに、半導体産業新聞上海支局にて作成
2012. 8/10 「中国『太陽電池』2015年に何が起るかセミナー」 産業タイムズ社上海支局 7/19

Monday, Sept. 9, 2013

Chair: Masatoshi Okada

13:00-13:20	Nano integration technology for high-performance sensing and probing Xinxin LI State Key Laboratory of Transducer Technology, SIMIT
13:20-13:40	Development of the EUV Resist at Center for EUVL Takeo WATANABE Center for EUVL, Laboratory of Advanced Science and Technology for Industry, University of Hyogo
13:40-14:00	Directed Self Assembly Materials for Semiconductor Fabrication Yoshikazu YAMAGUCHI Fine Electronic Materials, Research Laboratory, JSR Corporation
14:00-14:20	Highly Functional Materials Technology of FUJIFILM Takahiro GOTO Electronic Materials Research Laboratories, FUJIFILM Corporation
14:20-14:40	Coffee Break

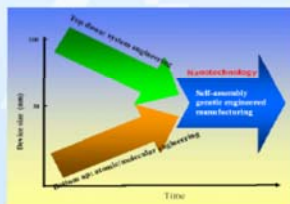
Nano Integration Technology for High-performance Sensing and Probing

Prof. Xinxin Li, Professor and Director
State Key Lab of Transducer Technology

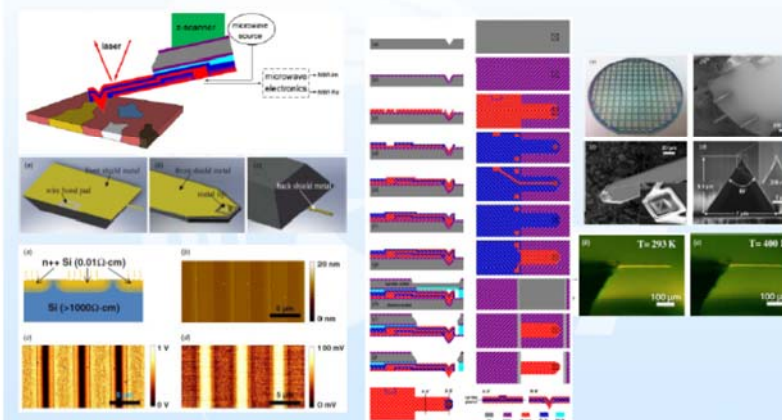
Along with dimensional shrinkage from micro to nano, MEMS is extended down to NEMS

Nano fabrication technology needs to be intensively explored

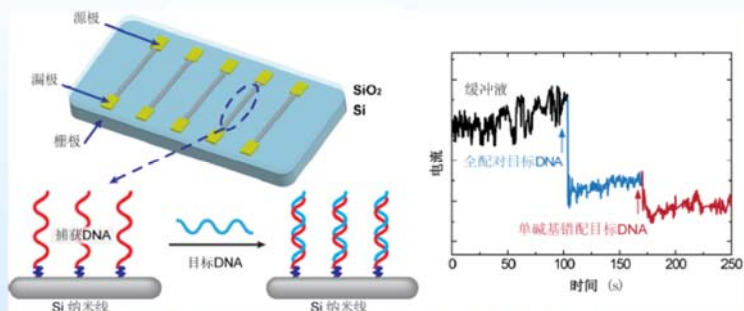
But herein nano fabrication is combined with micro, so, top-down and bottom-up is becoming compatible



Top-down fabricated 0-dimensional nano-tip



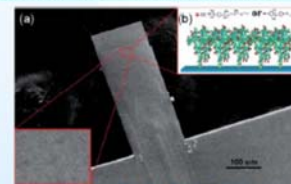
0.01fM biosensor



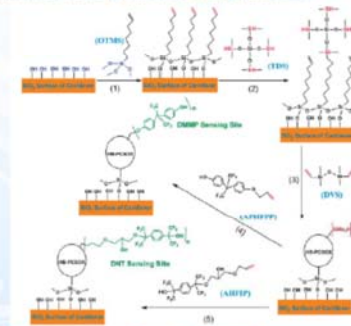
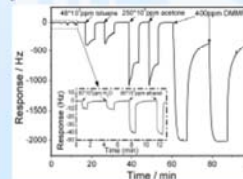
- Bio-probe: 5' -HOOC-CAC GAC GTT GTA AAA CGA CGG CCA G-3'
- Single bp mismatch: 5' -C TGG CCG TCG TTC TAC AAC GTC GTG-3'

Bottom-up grown sensing nano-materials

Hyper-branched nano-polymer grown on cantilever for sarin detection



$$\Delta f / f \propto \Delta k / k - \Delta m / m$$



Monday, Sept. 9, 2013

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Chair: Xinxin LI

14:40-15:00	Superconductivity in single unit cell thick $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}_x$ /graphene heterostructure Xiaoming XIE State Key Laboratory of Functional Materials for Informatics, Shanghai Center for Superconductivity, SIMIT
15:00-15:20	Magnetic sensor of Asahi Kasei Microdevices Naofumi UESUGI Asahi Kasei Microdevices (Shanghai) Co.,Ltd.
15:20-15:40	Development of Nanoimprint mold in TOPPAN Keisuke Mizuno, Niro WATANABE Business Development Center, TOPPAN PRINTING CO.,LTD
15:40-16:00	Introduction of Toray IT related materials and Novel Partial Esterification Reaction in Poly(amic acid) and Its Application for Positive-Tone Photosensitive Polyimide Precursor Masao TOMIKAWA Electronic & Imaging Materials Research Laboratories, Toray Industries, Inc
16:00-17:00	Visit showroom of SIMIT
19:00-21:00	Banquet

The 3rd Sino-Japan Symposium on Information and Electronic Materials

Superconductivity in single-unit-cell-thick $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}_x$ /graphene hetero-structure

Xiaoming XIE

State Key Laboratory of Functional Materials for Informatics (SKLFM)
Shanghai Center for Superconductivity (SC²), Chinese Academy of Sciences(CAS)

Research results to be published, please do not disclose

Brief introduction of SC²

SIMIT

Shanghai Center for Superconductivity (SC²)



Officially approved on December 20, 2012

Annual acquired budget: ~10 M US\$

The research team



Totally around 100

Staff: 63 (2 ten-thousand talents, 13 Prof. and 9 Assoc. Prof.)

Postdocs and graduate students: ~50

LEADERSHIP

Prof. Dr. JIANG Mianheng

Current major activities

Novel materials and electronic structures

- Exploration of novel superconductors
- Two dimensional atomic crystals
- Superconductor hybrid structures
- Atomically engineered materials and in-situ electronic structure investigations ...

Quantum devices

- SQUID, SNSPD, SIS,

System integration and applications

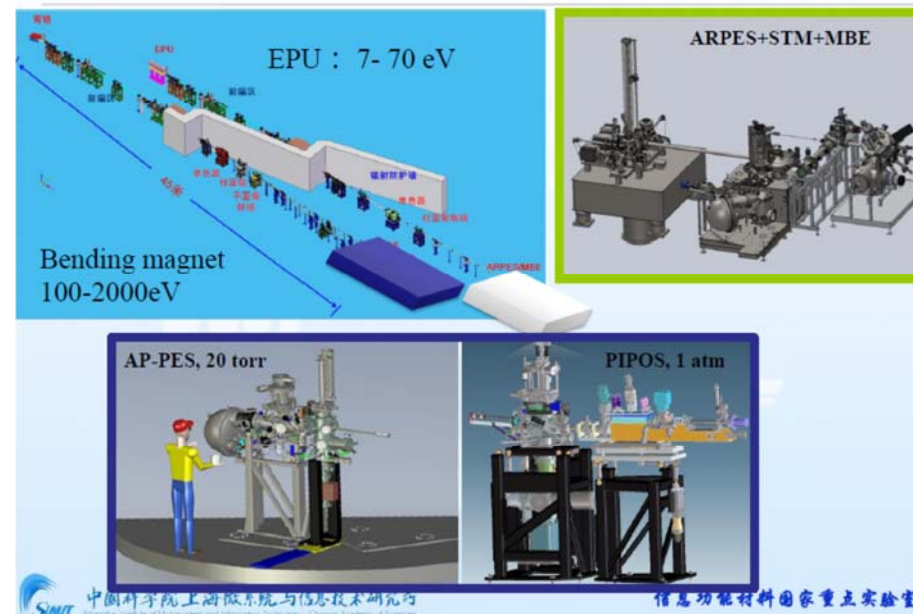
- Biomag, ultra low field MRI, geophysical prospecting
- QKD for quantum communication
- Quantum imaging, laser ranging...

Micro-fabrication platform

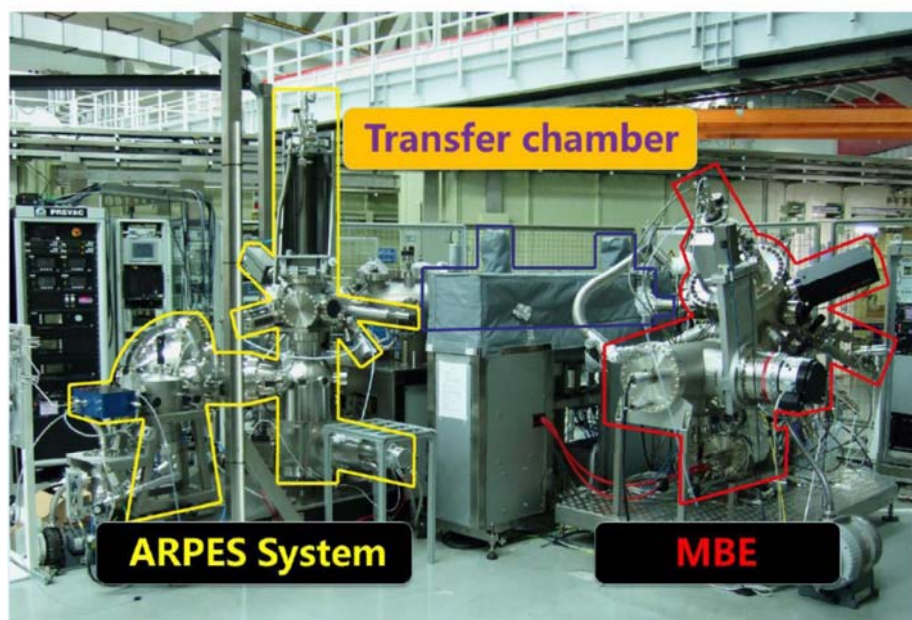


First phase investment: ~10M US\$;
 Clean room: 600 m² (100 class, 150m²)
 Capability: 4 inch, 5 nm, sub-micron junction
 Test operation: since Oct. 2012

Electronic structure



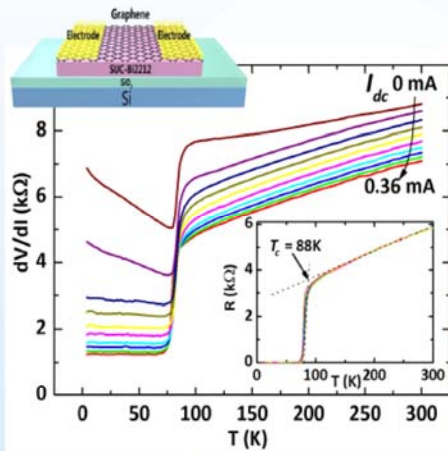
Platform for in situ electronic structure



Joint researches

- Joint Research Program on Superconductivity
 SIMIT-NICT, Since July 22, 2013
- Joint Research Laboratory on Quantum Materials
 SIMIT-Fudan University, Since April 10, 2013
- Joint Research Laboratory on Geophysical Exploration
 SIMIT-Jilin University (since Nov. 3, 2011)
- Joint Research Laboratory on Superconductivity and Bioelectronics
 SIMIT, Juelich Research Center, Germany, Since Oct. 20, 2010

Resistance versus temperature



Mixed current bias, measure differential resistance, 2 and 4 probe measurements

$I_{DC} = 0, 0.04, 0.08 \dots 0.36$ mA

$I_{AC} = 0.01$ mA

- Sharp transition at 88K
- Anomalous at low bias (interface barrier? Andreev reflection?)
- Temperature independent residual resistance at high bias

Summary

1. The first single cell thick superconductor with T_c above 77K
2. Many peculiar phenomenon observed, leading to a door never opened before
3. The experimental platform is versatile, applicable to other atomic crystals.

Thanks for your attention

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The Status of SSRF

Shanghai Synchrotron Radiation Facility
Shanghai Institute of Applied Physics, CAS, China



Shanghai Synchrotron Radiation Facility

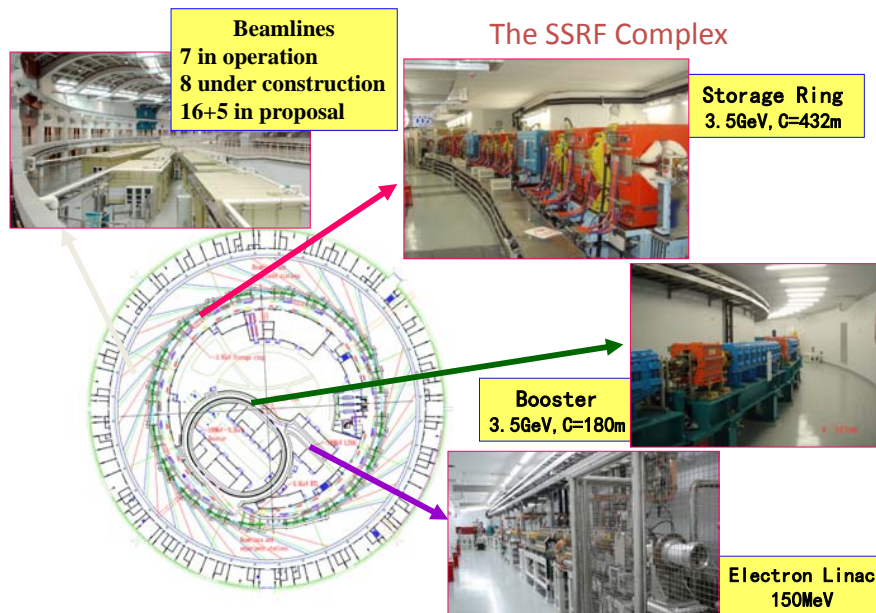
SSRF is an intermediate energy 3rd generation light source funded by Chinese Academy of Sciences (CAS), Shanghai local government and central government of China;

Major scientific fields of SSRF(phase I)

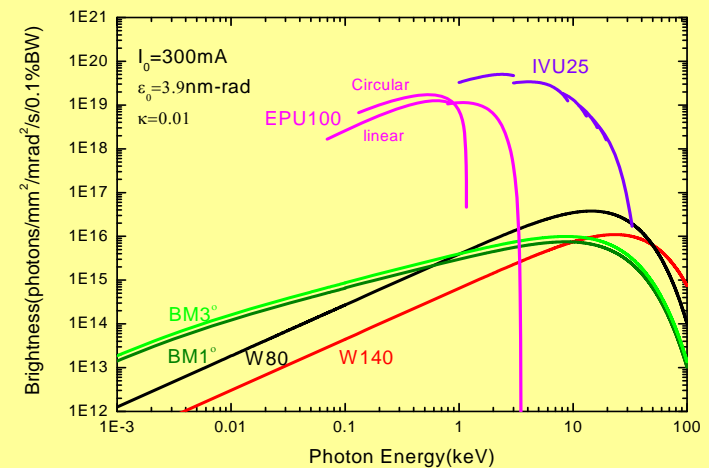
- Biological Sciences
- Physical and Materials Sciences
- Chemical and Environment Sciences
- BioMedical and Industrial Applications

Main Parameters of Storage Ring

- Storage Ring Energy: 3.5 GeV
- Circumference: 432 m
- Natural Emittance: 3.9 nm-rad
- Beam Current: 200 ~ 300 mA
- Beam Lifetime: ~20 hrs/ Top-up
- Straight Sections: 4×12.0 m, 16×6.5 m
- RF Voltage: 4.0~6.0 MV
- Max. Beam Power: ~600kW



SSRF provides very bright photon beams from 0.1-20keV



SSRF Phase I Beamlines

- ◆ [Macromolecular Crystallography Beamline\(IVU\)](#)
- ◆ [Diffraction Beamline \(BM\)](#)
- ◆ [XAFS Beamline \(Wiggler, W80\)](#)
- ◆ [Hard X-ray Microfocusing Beamline\(IVU25\)](#)
- ◆ [X-ray Imaging Beamline \(wiggler, W120\)](#)
- ◆ [Small Angle X-ray Scattering Beamline \(BM\)](#)
- ◆ [Soft X-ray Spectromicroscopy Beamline \(EPU\)](#)

The available sources and allocation in SSRF

Sources	Available number	Status	Used number	Remaining number
Standard straight sections	16	SSRF Phase-I 7 BIs (In operation)	5	0
		National Protein Facility 3 BIs (Under construction)	4	
		SiP-ME2 Project 1BI (Under construction)		
		Dreamline Project 1BI (Under construction)		
		SSRF Phase-II Beamline Project 6 BIs(Proposed)	6	
		Sinopec Project 1BI (Proposed)	1	
Long straight sections	2	High Pressure DAC Project 2 BIs (Proposed)	1	0
		SSRF Phase-II Beamline Project 2 BIs(Proposed)	1	
BM	18	SSRF Phase-I 2 BIs (In Operation)	2	5
		National Protein Facility 2 BIs (Under construction)	3	
		SiP-ME2 Project 1BI (Under construction)		
		SSRF Phase-II Beamline Project 3 BIs(Proposed)	3	
		Sinopec Project 1BI (Proposed)	1	
For Super B	4			
Infrared ports	4	National Protein Facility 1 BI (Under construction)	1	2
		SSRF Phase-II Beamline Project 1 BI (Proposed)	1	
Short straight sections (to be updated)	3	SSRF Phase-II Beamline Project 2 BIs(Proposed)	2	0
		Sinopec Project 1BI (Proposed)	1	
Super B (to be updated)	3	SSRF Phase-II Beamline Project 3 BIs(Proposed)	3	0

Green: in operation, Red: phase-II beamlines, Blue: under construction, Black: proposed .

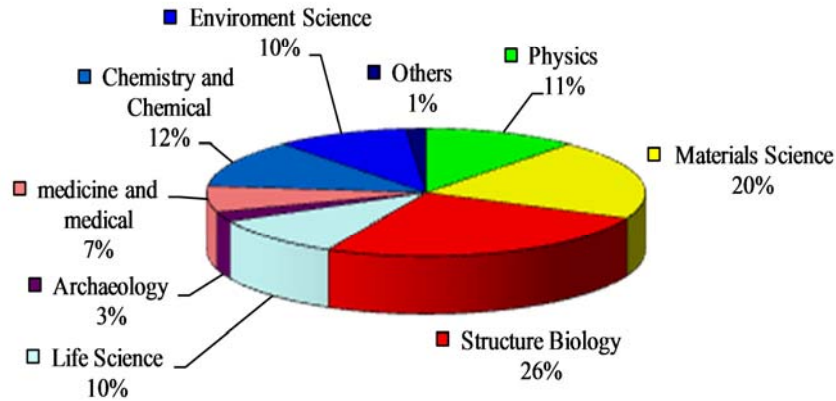
Current User Operation Status

- ❑ User operation started from May 6, 2009;
- ❑ By Dec 3, 2012, more than 4603 users from 260 universities and institutes carried out 3197 experiments at SSRF;
- ❑ User demand 3 times more than capacity;
- ❑ User operation time was 14542 hours in 2009 , increased to 27653 hours in 2011.

Active Research Fields at SSRF

- Structural Biology
- Catalyst
- Condensed Matters and Materials
- Environmental science
- Biomedical
- Industry

Distribution of users' research fields



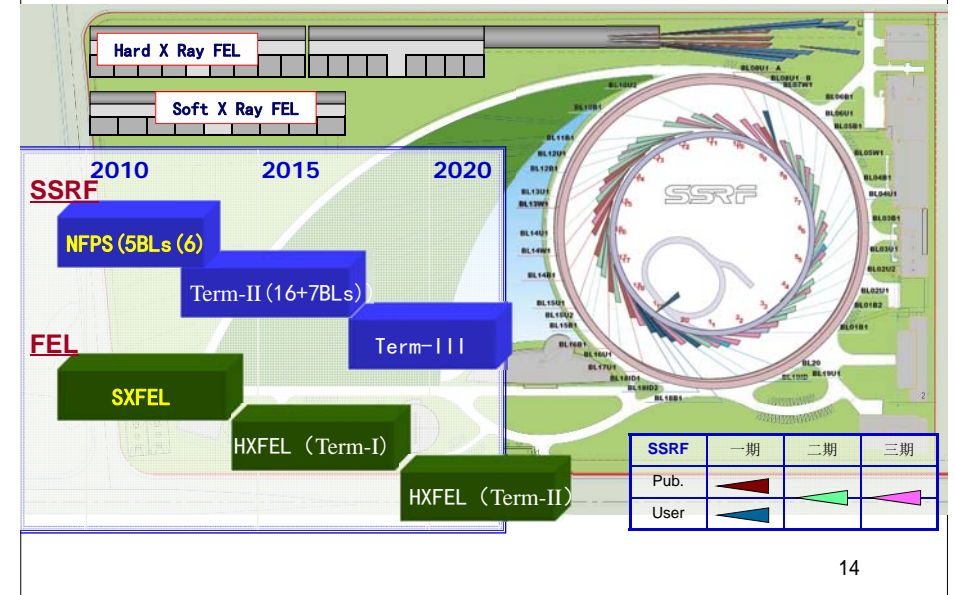
SSRF Phase-II Beamline Project

- ❑ Constructing 16 new advanced beamlines;
- ❑ Machine upgrading (superbends, 2m short straights, 3rd-harmonic cavity, cryogenic system)
- ❑ Supporting Labs: Beamline supporting (metrology, machining, electronics and engineering analysis), Experiment supporting (material, in-situ equipment pool, chemistry, biology and computer center)
- ❑ Buildings and Utilities: for long beamlines, guest house, and user training center;
- ❑ Construction period: 6 years

FEL programs

- ◆ Shanghai Soft X-ray FEL Project
- The project has been approved.

Shanghai Center of Photon Science



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14:00 海尼赛拉传感器有限公司

16:00発 高速道 貸切車で蘇州工業園區に移動

9月11日(水)

9:30~12:00 中科院蘇州ナノ研究所

12:00~13:15 昼食懇親会

13:30 無錫へ移動

14:30~15:30 東京大学無錫代表所

15:30~16:00 無錫駅へ移動

16:30 無錫発 G20高速動車 21:09北京南着

9月14日(土)

9:00-12:00 北京理工大学でEUVL技術に関する講義

12:00-13:00 昼食懇親会

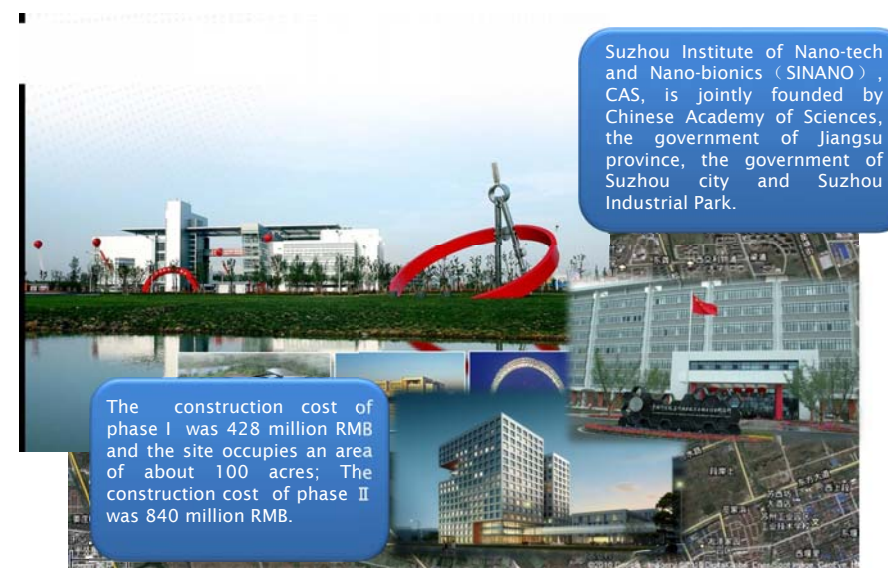
18:00-20:00 懇親会



1. History



2. General Information

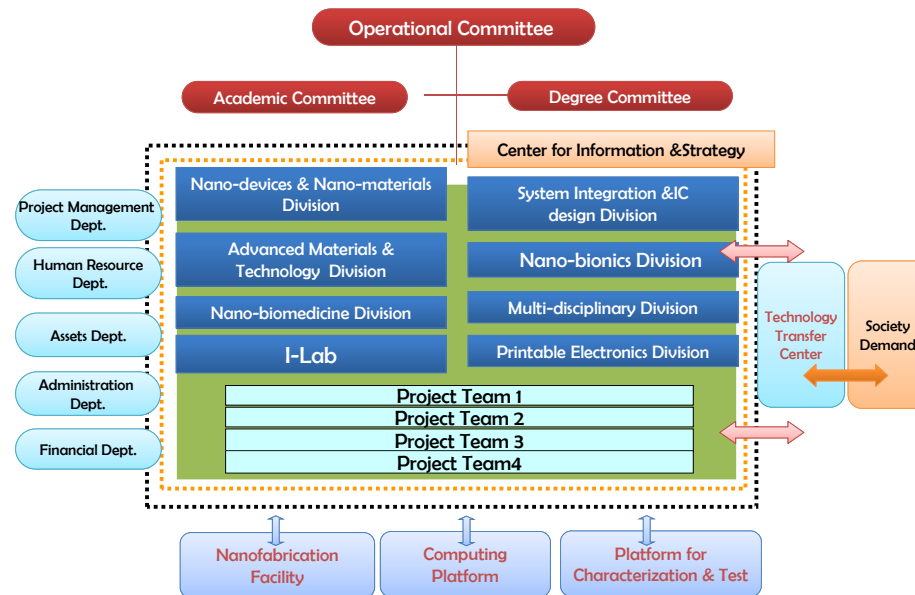


3. Mission of SINANO

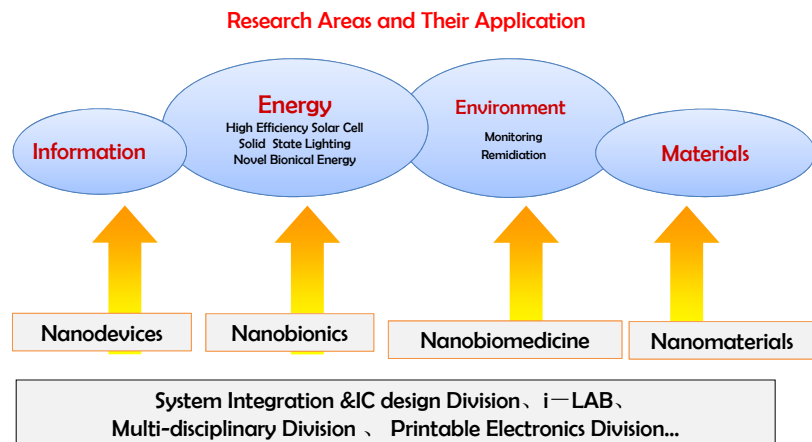


- To focus on applied research and industrialization of nanotechnology to meet the needs of national economic and social development and national security.
- To stay in the forefront of world science and to help local economic and social development.
- To aim to conduct basic, strategic and forward-looking innovation research, strives to play a leading role as a national research institute in nanotechnology.
- To provide supports for the ongoing industrial restructuring at local and national level.

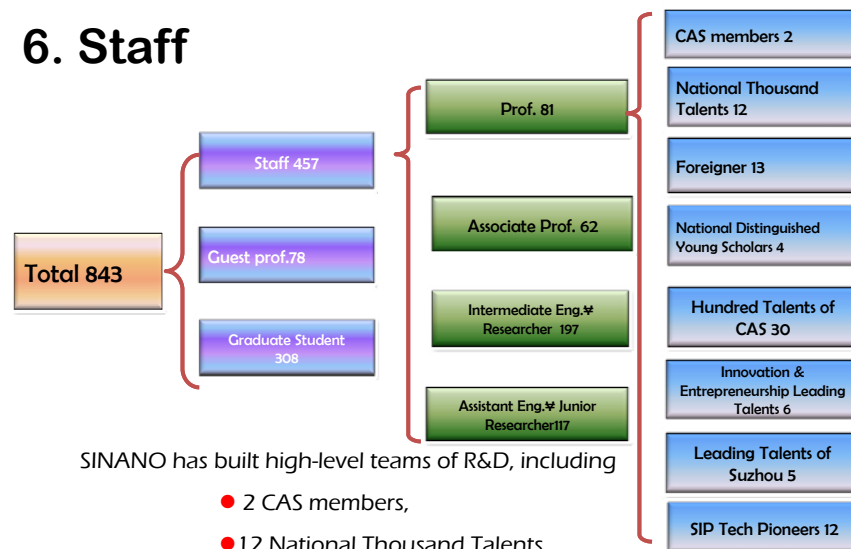
4. Organizational Structure



5. Research Field



6. Staff



SINANO has built high-level teams of R&D, including

- 2 CAS members,
- 12 National Thousand Talents,
- 4 National Distinguished Young Scholars
- 30 Hundred Talents of CAS.

第3回日中電子材料シンポジウム訪中国の日程(その1)

9月9日(月)

9:00~16:00 上海 研究会 中国科学院上海微系統と情報技術研究所
16:00~17:00 Showroom見学
19:00~21:00 懇親会

9月10日(火)

9:30 上海同期放射光源 (益先生途中下車帰国14:05浦東発)
14:00 海尼赛拉传感器有限公司
16:00発 高速道 貸切車で蘇州工業園区に移動

9月11日(水)

9:30~12:00 中科院蘇州ナノ研究所
12:00~13:15 昼食懇親会
13:30 無錫へ移動

14:30~15:30 東京大学無錫代表所

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9月14日(土)

9:00-12:00 北京理工大学でEUVL技術に関する講義
12:00-13:00 昼食懇親会
18:00-20:00 懇親会

東京大学無錫代表処

The University of Tokyo WuXi Representative Office

国際産学研究センター

International University-Industry Collaboration Center

Office opened: Nov. 4th, 2005 (new office: March 22nd ~, 2010)

Lab opened: March 22nd, 2010

Managed by: School of Engineering, U-Tokyo

Location: Ipark-II, WuXi New District (WND), Jiangsu Province, China

東京大学無錫代表処

The University of Tokyo WuXi Representative Office



注册: 2005年11月4日

管理: 東京大学 工学系研究科

位置: 中国 江苏省 無錫市 新区 無錫(国家)软件园 (iPark-II)

首席代表: 東京大学工学系研究科, 研究科長 原田教授

委員会: 田中教授 (運営委員会委員長) 前川教授 (国際事業推進センター長)

須賀教授 吉田教授

代表: 王 英輝 特任研究員

特別代表: 陽振 学術支援員

中国江苏省無錫市 新区

無錫 (国家)软件园 (iPark-II)

Mission

1. Establish Long-term Collaboration on Research with Universities and Research Institutes in China.
2. International University-Industry Cooperation.
3. U-Tokyo Int. Univ.-Industry Cooperation (WuXi) center
4. Visiting scholars and visiting students program.



History of UT-WND Cooperation



Opening Ceremony

@WuXi, Nov.4th, 2005

Agreement (WND-UT)
for 2nd 5 years Cooperation
@Tokyo, June 12th, 2009



University (UT-CHN Univ.) & Industry (JPN-CHN) Cooperation on Semiconductor Technology, Sensor Network, Environmental Issue, and others in Engineering Field at WND.

東京大学無錫代表処
Office

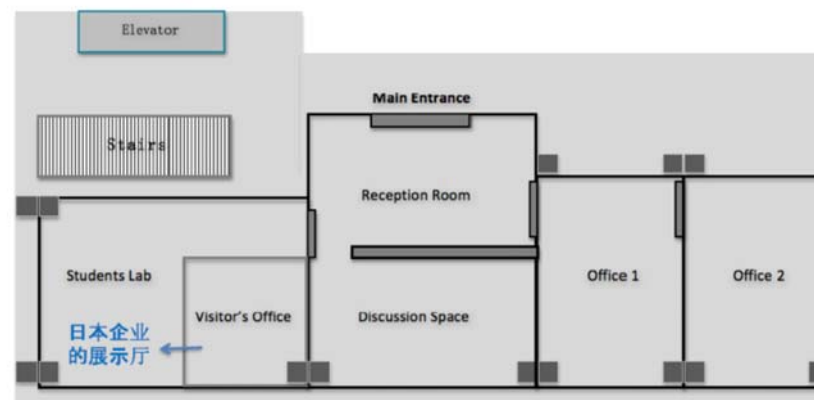


Address (2010.1~):

中国江苏省無錫市新区震沢道18号
無錫(国家)软件园(iPark-II)
Office: 射手座A棟2階201-203
Lab: 狮子座A棟1階1-1



Office Layout



Main Facilities :

U-Tokyo WuXi Office, Live TV Meeting System, Professor Office, Students Office
Discussion Space, Industry-partner Office, High-Speed Internet (TOTAL: 200 m2)



Mission A: Establish Long-term Collaboration on Research with Chinese Universities and Research Institutes.

- Peking University, Tsinghua University, USTC, Shanghai Jiaotong University, Fudan University, Jiangnan University...
- CAS...

Mission B: International University-Industry Cooperation.



Joint Lab with NPO and JPC
→ Green materials analysis

Joint Program with JST and SJTU
→ Environmental friendly lead-free solder packaging technology

- On-going: High-density IC packaging R&D.
- Under consideration: Sensor Network, Green MEMS, and Green Manufacture...

Mission C: Visiting students, interview, other related activities.



Cleanroom Layout



Details :

Cleanroom 1: class 1,000 / ~150m²; Cleanroom 2: class 100,000 / ~50m²
 Facilities Room: ~40 m²; Others: ~40 m²; TOTAL: 300 m²
 Equipments (details in section 3); Network Camera

<共同研究>



まとめ

- 1) 現在の中国の半導体技術は、微細加工、MEMSの観点から日本と比べて10年程度遅れている。
- 2) しかしながら、10年前に中国では、クリーンルームには壁がなく、カーテンで仕切られていた。
- 3) 今後10年後には、完全に追い抜かれることを覚悟せねばならない。
- 4) 日本が今後も技術立国であり続けるためには、新しい技術開発に選択集中する必要がある。
- 5) このためには、より一層に産学官連携を図る必要がある。これには、組織間の壁を低くし、真の連携を図る必要がある。