

## Industry-Academia Collaboration in NAIST

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Industry-Government-Academia Collaboration  
Nara Institute of Science and Technology (NAIST)

1

## Introduction to NAIST

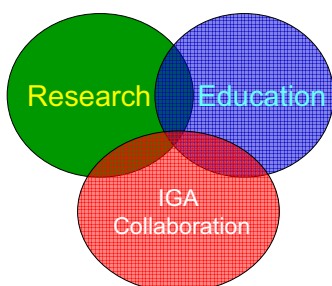
- Established in 1991, only 16 years young
  - National University Corporation
  - Graduate School-only University
- Three Faculties
  - Information Science
  - Biological Science
  - Materials Science
- Personnel
 

|                      |      |
|----------------------|------|
| □ Faculty Members    | 215  |
| □ Clerical Employees | 161  |
| □ Students           | 1080 |

2

## Industry-Government-Academia (IGA) Collaboration

- IGA Collaboration Group is established in 2004
- Policy: IGA collaboration is an Important mission beside research and education
  - Generation of new industry
  - Increase of employment



3

## Activities of NAIST & IGA Collaboration

per-faculty-member basis in Japan

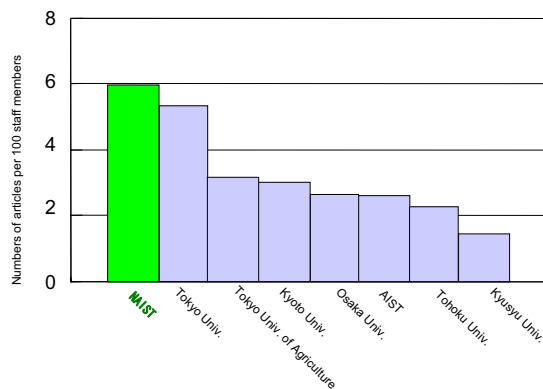
- No.1 in Articles published in Nature and Science
- No.3 in the External Source of Funding
- No.1 in the number of Patent Applications
- No.1 in Licensing Income

in Japan

- No.5 in Licensing Income

4

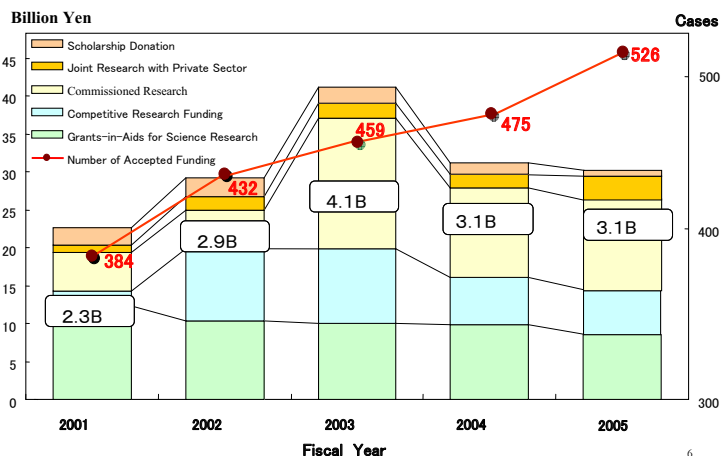
## Articles published in *Nature* and *Science*



(1999-2004, "College rankings in 2006," Asahi Shimbun)

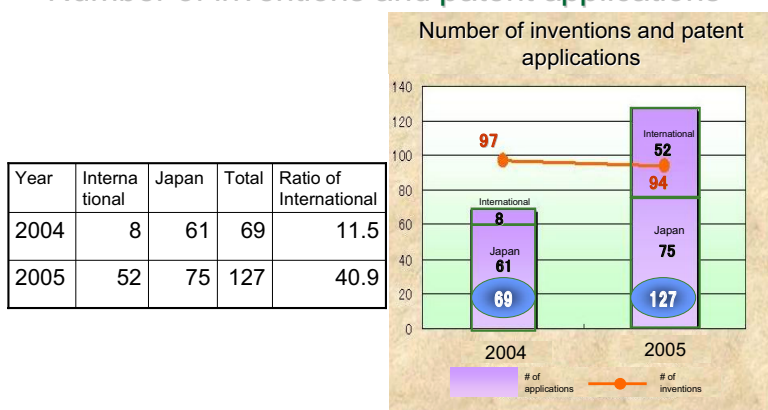
5

## External Sources of Funding



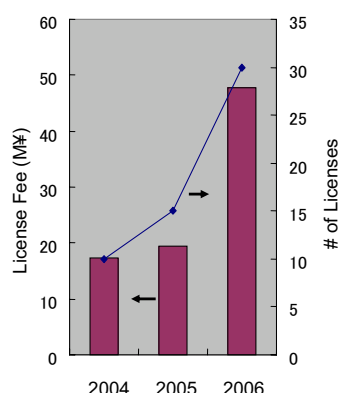
6

## Number of inventions and patent applications



7

## Licensing Activities



| Licensing Fee in 2006      |      |                    |  |
|----------------------------|------|--------------------|--|
| Japan                      | Case | Licensing Fee (M¥) |  |
| Patent                     | 9    | 14.56              |  |
| Material Transfer          | 8    | 11.26              |  |
| Technical Know-how         | 4    | 4.36               |  |
| Subtotal                   | 22   | 30.20              |  |
| International              | Case | Licensing Fee (M¥) |  |
| Patent                     | 3    | 6.01               |  |
| Material Transfer          | 4    | 9.63               |  |
| Technical Know-how         | 1    | 2.00               |  |
| Subtotal                   | 8    | 17.64              |  |
| Total                      | 30   | 47.8               |  |
| Average per faculty member |      | 0.23               |  |

8

## International Exhibitions & Seminars

- NAIST Seminar in Santa Clara
  - August 21, 2007 IT & Material Technology
- NAIST Seminar in Philadelphia
  - October 1, 2007 Bio-Technology
- Exhibition in IEEE NSC/MIC
  - Oct 30 – Nov 1, 2007 Surgical Simulation
- Exhibition in Bioasia 2007
  - Nov 7 – Nov 9, 2007 Bio-Technology
- Exhibition in JUNBA 2008
  - Jan 11, 2008 Surgical Simulation

9

**Nara Institute of Science and Technology (NAIST) presents a One-Day Seminar in the Santa Clara Valley:**

**IT and Materials Technologies: Bio Nano Process, Sound Separation, Solar-Cell Inspection and Other Technologies from Japan**

**Tuesday August 21, 2007**  
**9:30 AM – 5:00 PM**

**Place:** UC-Santa Cruz Extension, Moffett Business Park, 1180 Bordeaux Drive, Sunnyvale

**Morning Topics: (9:30 AM – Noon)**  
**Development and Properties of Luminescent Chalcogenide Nanocrystals**  
 Professor T. Kawai  
 CdTe nanocrystals showing high emission quantum yield with no protecting layer – act as efficient emitting and photo-sensitive material in photo-polymerization system. Potential as efficient high-density optical recording medium and solar cell.

**A Versatile Tool for the Diagnosis of Crystalline-Silicon Solar Cells Using Electroluminescence**  
 Professor T. Fuyuki  
 Forward bias electroluminescence intensity is related to minority carriers. Defects, grain boundaries, cracks are detected as dark spots, lines, and areas. Versatile tool to evaluate cell fabrication process and performance.

**Lunch is served at Noon**

**Registration: BEFORE AUGUST 7** There is **no charge** for this seminar, but we need an accurate count by August 7 in order to properly schedule conference room space.

**Register today** to assure a seat. Fax/email to: UC-Santa Cruz Extension: NAIST Seminar  
 1101 Pacific Avenue, Suite 208  
 Santa Cruz, CA 95060 FAX: +1-531-427-1827  
 Email: smuller@ucsc-extension.edu

**Afternoon Topics: (1:00 PM – 5:00 PM)**  
**Pocket-Size Real-Time Blind Source Separation (BSS) Module for Hands-Free Speech Acquisition**  
 Associate Professor H. Saruwatari  
 BSS estimates original sound sources using mixed signals detected by multiple microphones. This algorithm uses independent component analysis and binary masking, isolating human brain and ears. Potential for clear reception of cell-phone call amid noise. Portable, with a delay time of less than 50msec.

**Tactile Sensors for Advanced Robotics**  
 Assistant Professor J. Ueda  
 Vision-based tactile sensor and slip prediction method: Fingerprint pointing device for mobile application; Teaching playback of dextrous robot manipulation; MRI compatible force sensor; Tactile information processing for robotic manipulation and human-machine interfaces

**CMOS Technologies for Biological and Medical Applications** Professor J. Ohta  
 Highly functional/versatile biomedical devices: retinal prosthesis, brain implantation, and future issues for bionic human uses of implantable CMOS technologies.

**Bio Nano Process – Fabrication of Inorganic Nanostructures by Protein Supramolecules**  
 Professors I. Yamashita and T. Fuyuki  
 Self-organization and biomimeticization of bio-supramolecules for fabricating inorganic structures for nano-electronic devices: Memory nanodot array in a floating gate memory; a proposed biological path to nano-electronics.

10

## Evaluation of NAIST in IGA Collaboration

- Government assessment on IGA Collaboration:
  - Grade A
- Selected as a member of “Super IGA Collaboration Group”
  - Only 6 universities were selected:
  - Tokyo Univ., Kyoto Univ., Osaka Univ., Tokyo Institute of Technology, **NAIST**, Tokyo Univ. of Agriculture
- Though it is 16 years young and its size is small, NAIST has already established its position as an institution supplying industries with useful technologies in IT, biological, and materials sciences.

11

## Introduction of NAIST Technology in Information & Materials Sciences

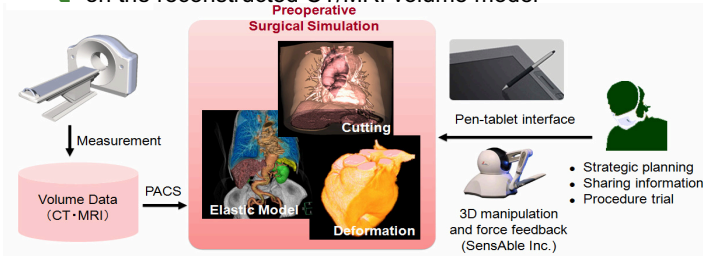
- Information Science
  - Surgical Simulation
- Materials Science
  - Applied Physics
    - Wide-Angle Ellipsoidal-Mesh Lens for Electron Analyzer
  - Materials & Devices for Information Science
    - Diagnosis of Silicon Solar Cells Utilizing EL
    - Bio Nano Process
    - CMOS Bionics
    - All-optical buffer memory
  - Chemical Materials
    - Highly Luminescent Nanocrystals & Lanthanide Materials
  - Biological Materials
    - Cerasome as a Novel Organic-Inorganic Nanohybrid
    - Biocompatible Materials

12

## Tailor-made Surgical Simulation

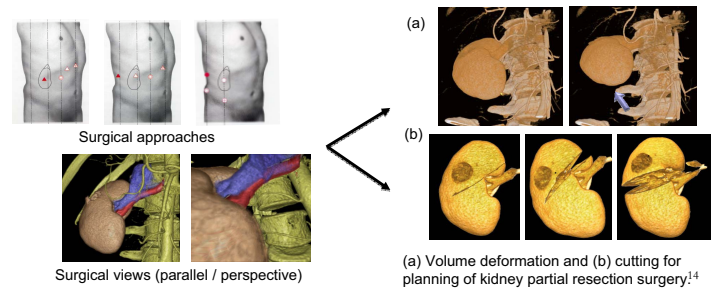
### Volume Surgical Simulation

- allows medical staffs to try surgical procedure (cutting and manipulation of the tumor etc.)
- on the reconstructed CT/MRI volume model



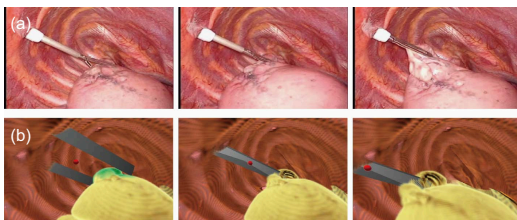
## Example 1: Urological Surgery Simulation

- Surgical procedure : kidney tumor resection
- This system helps surgeons to decide surgical approach
- Real-time deformation and cutting is possible



## Example 2: Thoracoscopic Surgery Simulation

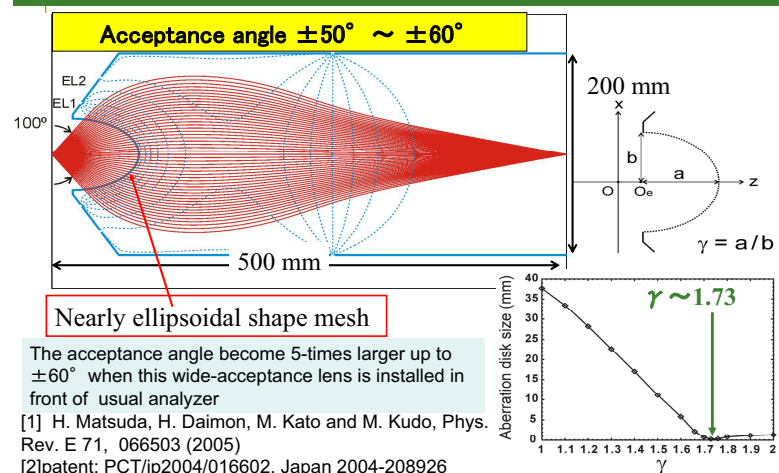
- Surgical procedure : lung tumor resection
- Limited view and tumors move through deformation
- Surgical videos and simulation results for evaluation



Lung deformation in thoracoscopic surgery.  
(a) surgical videos and (b) volume deformation results

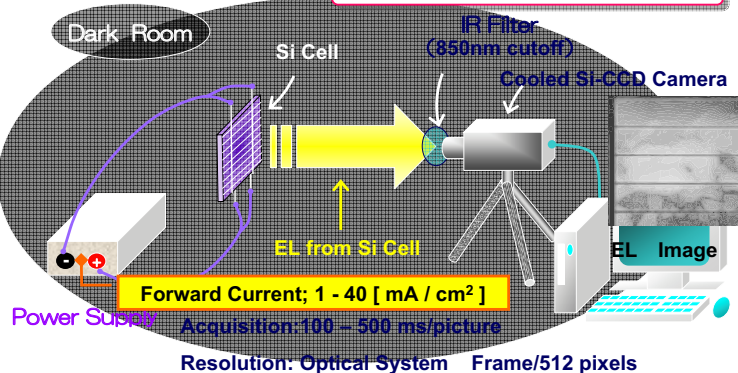
15

## Wide-Angle Ellipsoidal-Mesh Lens



## Diagnosis of Silicon Solar Cells Utilizing Electroluminescence

\*Simple and Quick at Room Temp.

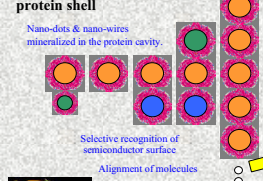


17

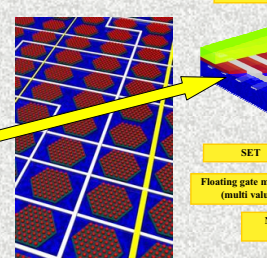
## Bio Nano Process

Making inorganic functional nano-structures for nanoelectronic devices using bio-supramolecules

**Bio-nano block**  
**Bio-mineralization**  
Making hetero complex;  
inner nanoparticle/nanowire and outer protein shell



**Self-assembly**  
Using self-assembly, protein-inorganic nano-structures are fabricated. → After elimination of protein moiety, nano-device key components are fabricated.

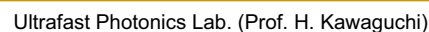


Top-down ↔ Bottom-up

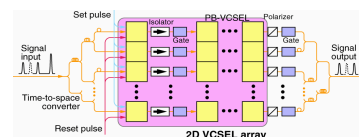
BNP



- CMOS technologies for Biomedical applications -



## All-optical buffer memory

2D optical buffer memory array<sup>[3]</sup>

- Optical buffer memory with shift register function
- 2D monolithic integration
- Shift register function<sup>[4]</sup>, parallel operation<sup>[5]</sup>, and 10 Gbps one-bit buffering<sup>[6]</sup> have been archived.

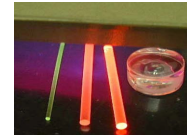
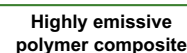
[1] H. Kawaguchi: IEEE J. Sel. Top. Quantum Electron. 3 (1997) 1254.  
[2] T. Mori et al.: Appl. Phys. Lett. 88 (2006) 101102.  
[3] H. Kawaguchi et al.: Jpn. J. Appl. Phys. 45 (2006) L894.  
[4] T. Mori et al.: CLEO 2007 CTuGG6.  
[5] T. Mori et al.: 2006 LEOS WJ2.  
[6] T. Mori et al.: ECOC 2007 3.4.3.

20

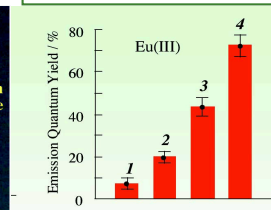
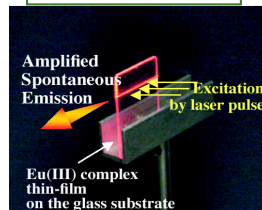
**Laboratory for Photonic Molecular Science**



**Laboratory for Photonic Molecular Science**



### Improved emission efficiency



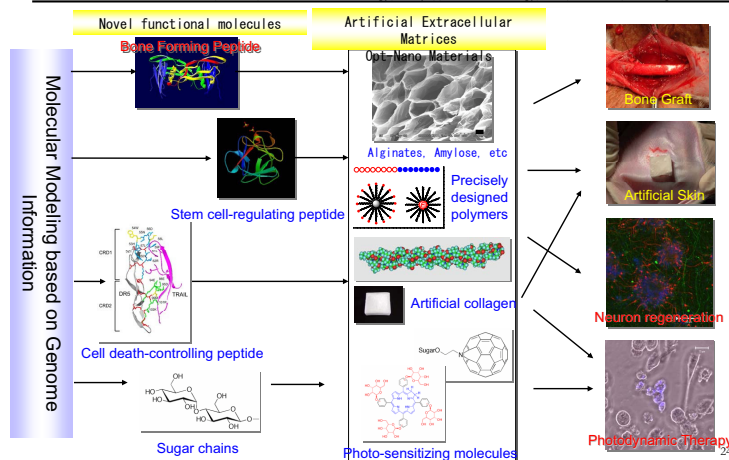
## Applications

- ◆ Display
- ◆ Security ink
- ◆ Bio-label
- ◆ IR-emitter
- ◆ Laser
- ◆ OLED

22

*Biocompatible Materials Science Laboratory*

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