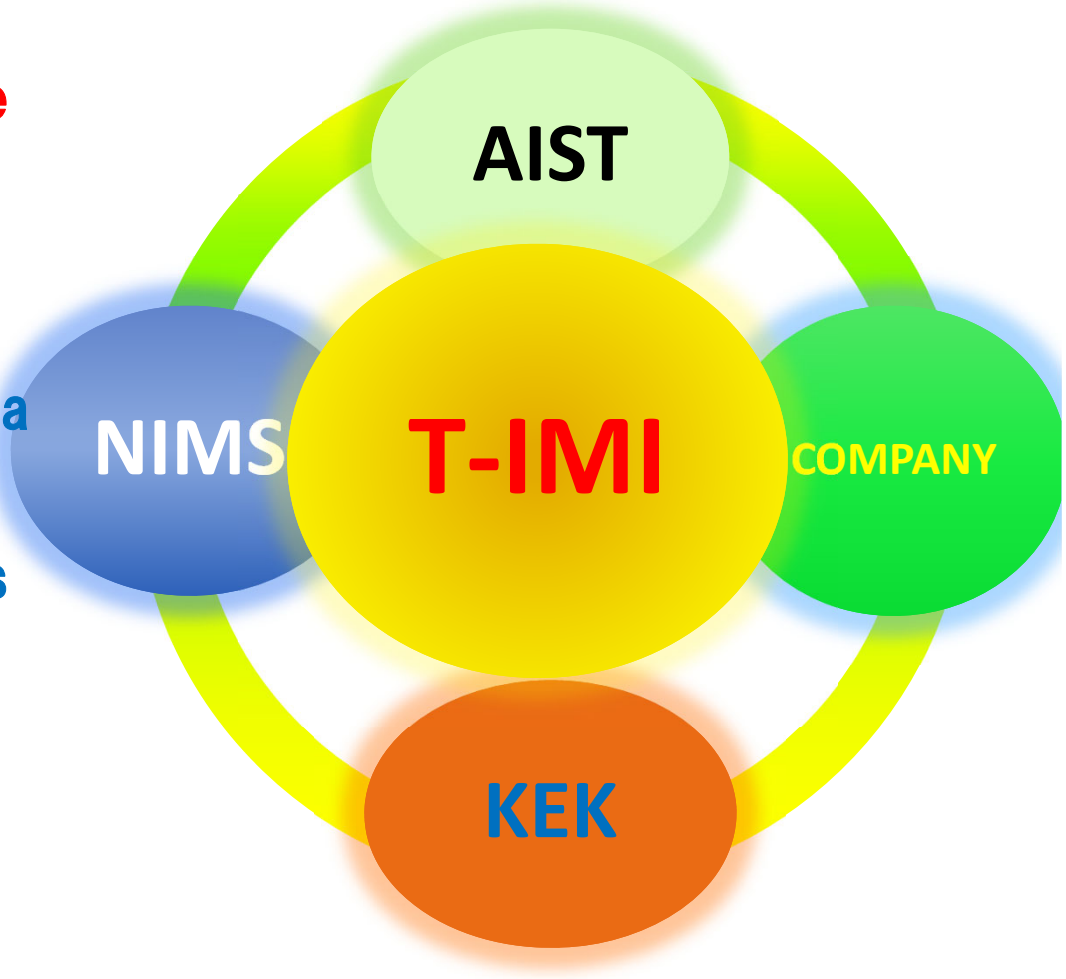
Master's and Doctoral Program in Materials Innovation

Objective

To produce internationally active talents leading innovation in future materials

7 characteristics

1. Education by English
2. First-class Professors in Tsukuba
3. Materials related
4. Small number-exceptional talents
5. Financial supports
6. Students from south east Asia
7. Collaborations with company



Started in 2020

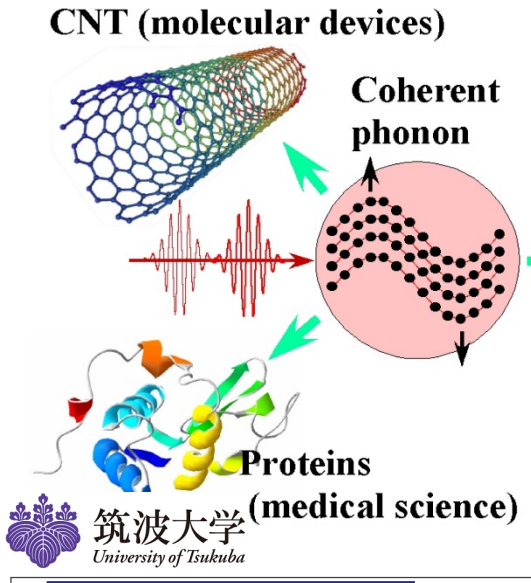
What kinds of materials innovation?

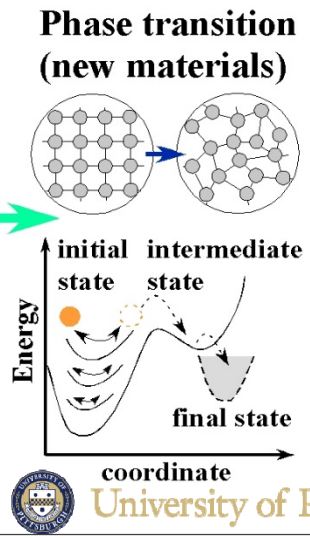
- Energy materials: Solar cells, Fuel cells, Battery, Thermoelectric materials
- Environmental materials: Catalysts, Algae oils
- Photo materials: Photonic materials, Light-emitting materials
- Electronics materials: Magnetic materials, Spintronic materials

Produce global leaders to dedicate world-wide energy and environmental problems

Ultrafast Science Group

Prof. Muneaki Hase

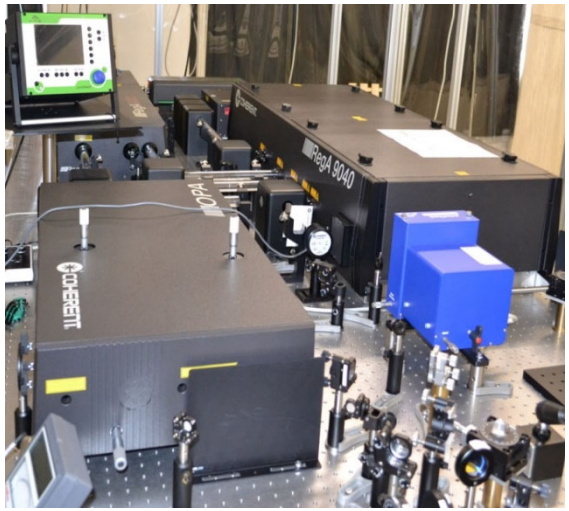




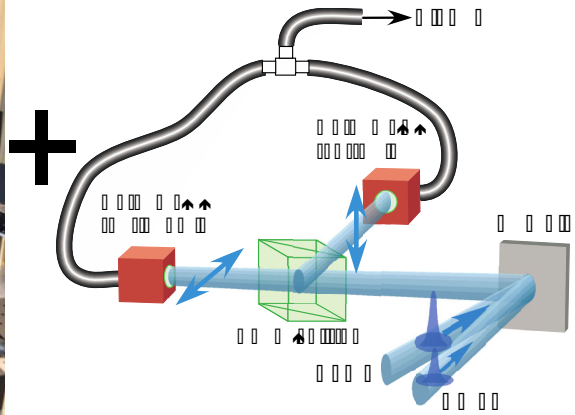
By using ultrashort laser pulses, we are studying physical and chemical phenomena in semiconductors, carbon nanotubes, and proteins. We aim to contribute to industrial and medical applications.

Our laser system

Femtosecond pulse laser (<40 fs)



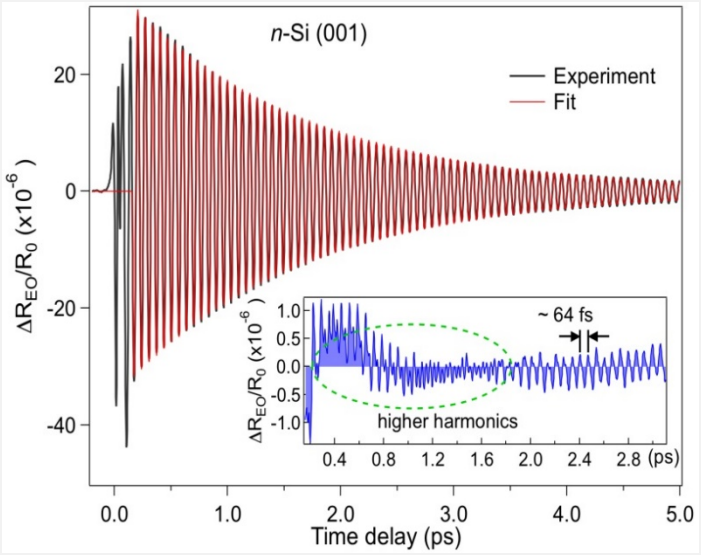
World top-class sensitivity of time-resolved pump-probe spectroscopic system



Optical parametric amplifier (OPA) enables us to extend the wavelength range from 500 nm to 1600 nm.

Results

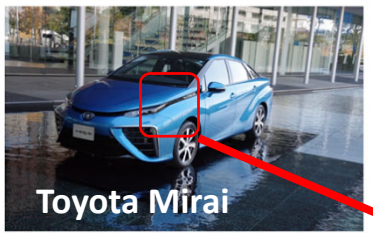
We have succeeded in observing coherent lattice vibrations in silicon.



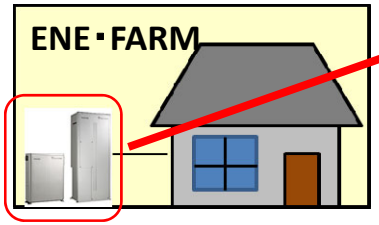
M. Hase *et al*, Nature Commun. **6**, 8367 (2015).
M. Hase *et al*, Nature Photon. **6**, 243-247 (2012).
M. Hase *et al*, Nature **426**, 51-54 (2003).

Active sites of carbon catalysts have been revealed !!

Fuel cell vehicle



Fuel cell for HOME



$O_2+4H^++4e^- \rightarrow 2H_2O$

catalysts

Current Fuel Cell Catalyst

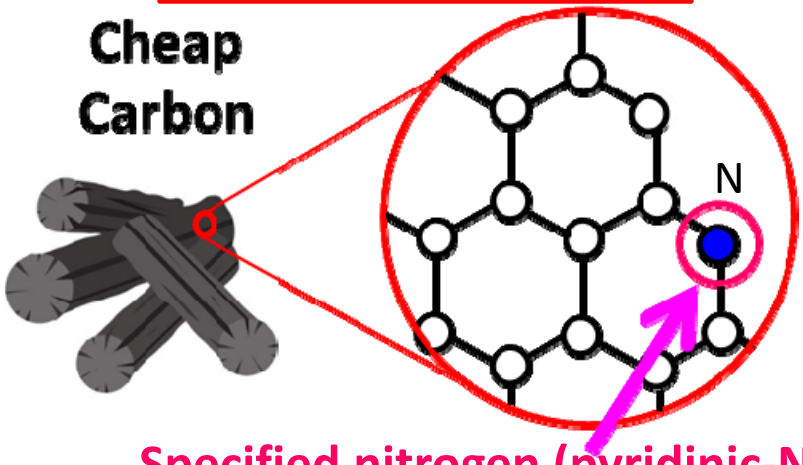
Rare metal

Platinum

Future Fuel Cell Catalyst

Cheap

Carbon



Specified nitrogen (pyridinic-N)

Pyridinic nitrogen creates active sites for oxygen reduction reaction

Science

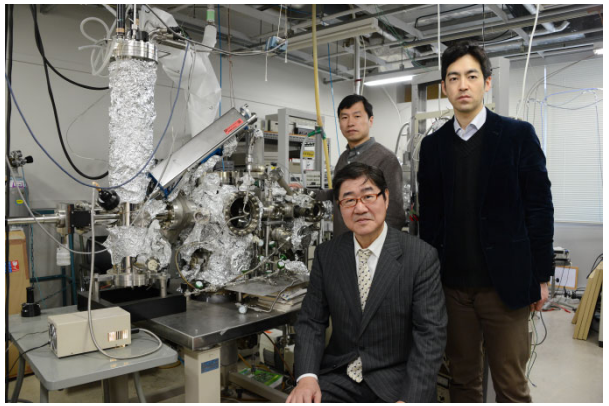
AAAS

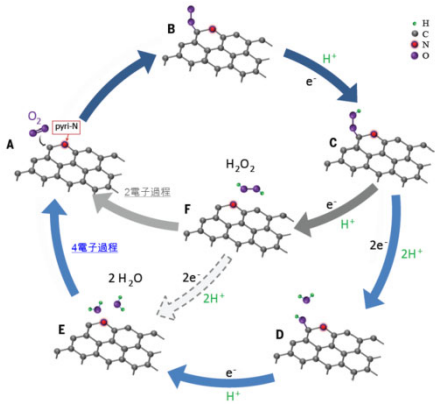
ELECTROCHEMISTRY

Active sites of nitrogen-doped carbon materials for oxygen reduction reaction clarified using model catalysts

Donghui Guo,[1] Riku Shibuya,[2] Chisato Akiba,[2] Shunsuke Saji,[2] Takahiro Kondo,[1]* Junji Nakamura[1]*

Nitrogen (N)–doped carbon materials exhibit high electrocatalytic activity for the oxygen reduction reaction (ORR), which is essential for several renewable energy systems. However, the ORR active site (or sites) is unclear, which retards further developments of high-performance catalysts. Here, we characterized the ORR active site by using newly designed graphite (highly oriented pyrolitic graphite) model catalysts with well-defined π conjugation and well-controlled doping of N species. The ORR active site is created by pyridinic N. Carbon dioxide adsorption experiments indicated that pyridinic N also creates Lewis basic sites. The specific activities per pyridinic N in the HOPG model catalysts are comparable with those of N-doped graphene powder catalysts. Thus, the ORR active sites in N-doped carbon materials are carbon atoms with Lewis basicity next to pyridinic N.



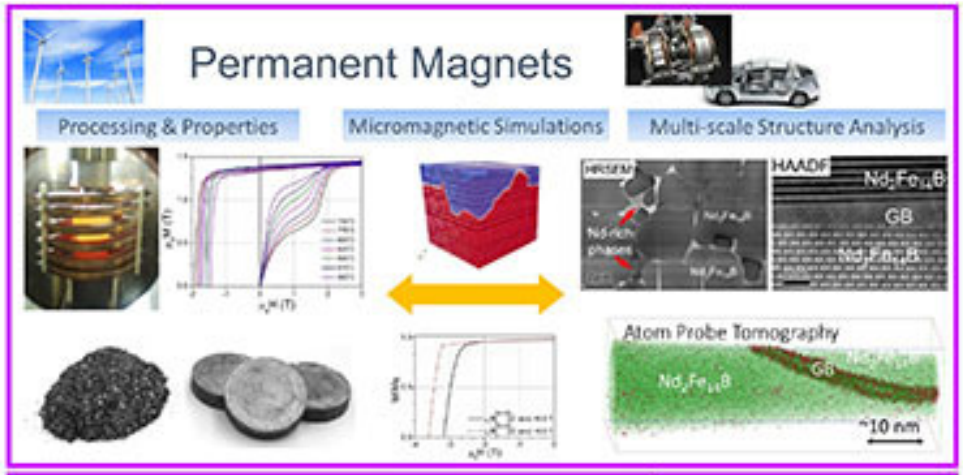


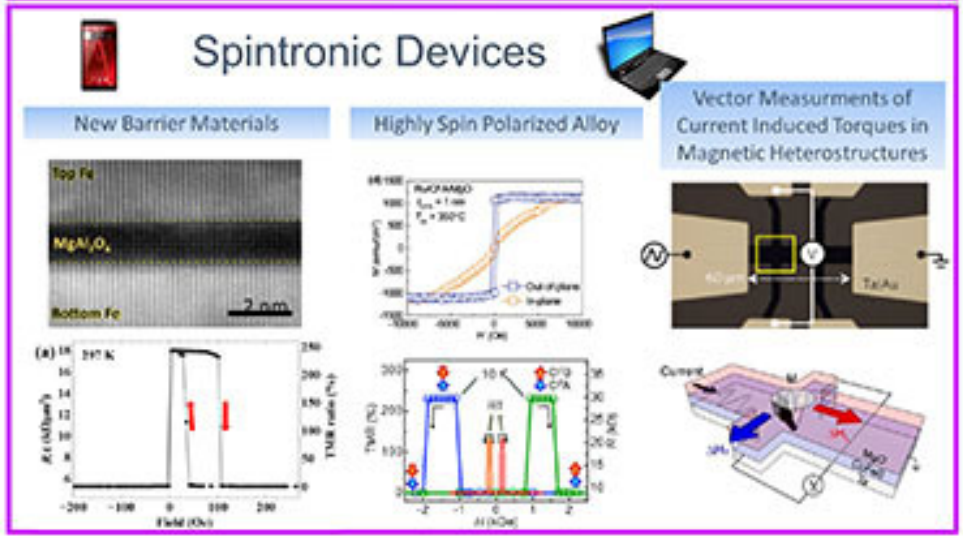
D. Guo, R. Shibuya, C. Akiba, S. Saji, T. Kondo, J. Nakamura, *Science* 351 (2016) 361.

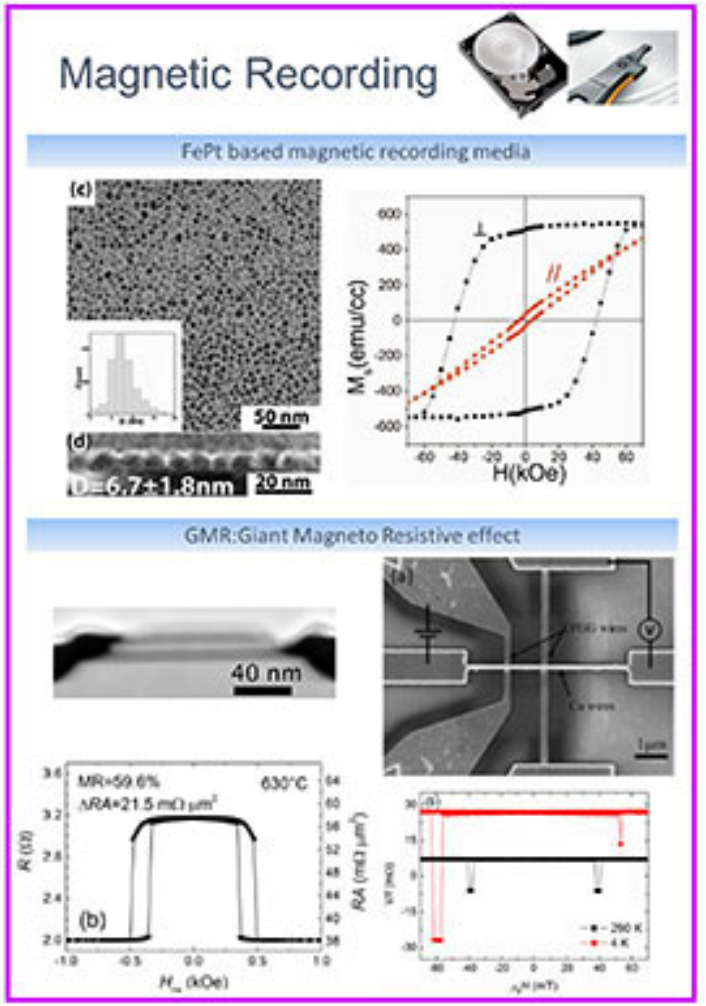
Prof. Kazuhiro Hono /NIMS

Executive Vice President, Director of Research Center for Magnetic and Spintronic Materials

Science 345, 1337 (2014) H-index = 100







こんなところに 産総研!

電子工学と磁気工学を融合させたスピントロニクス技術

〈待機電力ゼロ〉の夢のIT機器の登場も近い?

世界中がほしがる技術は産総研の基礎研究から生まれた!

私たちの生活・社会がこう変わる!

スピントロニクスから生まれた低消費電力型ハードディスクドライブ(HDD)ヘッドは、2007年に実用化されてパソコンの消費電力を大幅に削減した。今後、この技術をベースにした、より高機能な不揮発性メモリが実用化されれば、大容量でありながら待機電力を全く必要としない「ノーマリーオフ・コンピュータ」の実現に近づくことになる。電子機器の省エネルギー化が今にも増して進み、私たちが充電などの手間から解放されると同時に、地球環境問題の解決に大きく貢献できる。

ナノスピントロニクス研究センター 研究センター長
湯浅新治
YUASA SHINJI

世界シェア100%の画期的なHDD磁気ヘッド

パソコンや携帯電話などの電子機器を動かす、現代の私たちの生活に非常に身近な技術が「エレクトロニクス(電子工学)」だ。しかし問題は、電力消費量が大きいこと。パソコンをはじめとするIT機器の使用は今後も増え続け、それに伴って電力の消費量も増大していくことは間違いない。そのため、地球温暖化が世界的な問題となっている昨今、電子機器の消費電力量を抑えていくことは非常に重要な課題となっている。

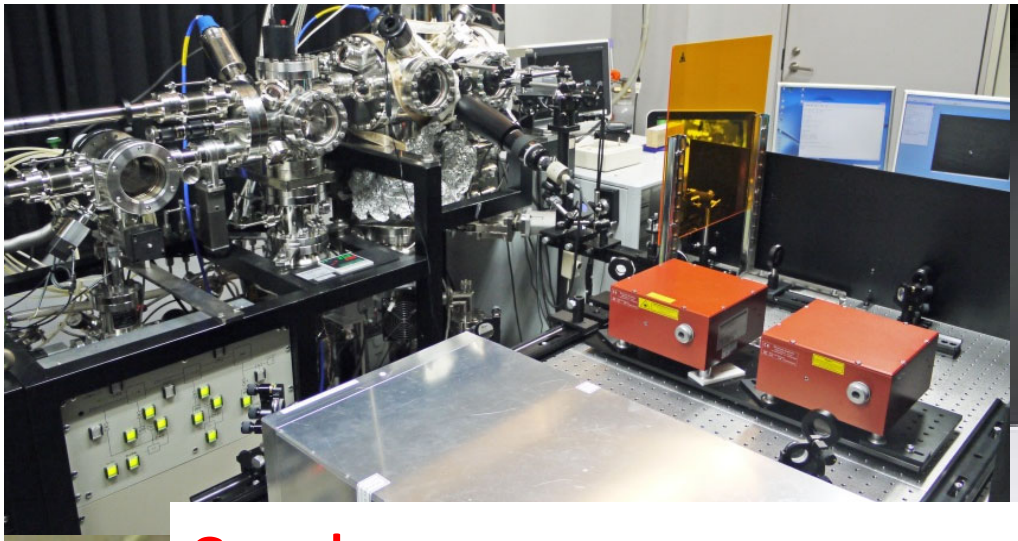
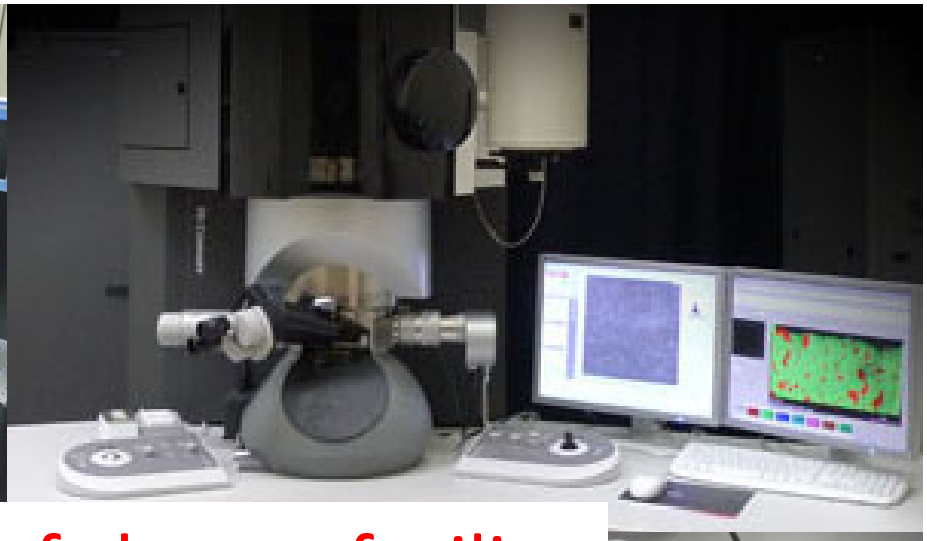
たとえばパソコンの場合、電力消費量が大きくなる原因は2つある。まず、ハードディスクドライブ(HDD)自体の消費電力が大きいこと、そしてメモリが揮発性であることだ。揮発性というのは、電源をオフにするとデー

4 ここにもあった産総研

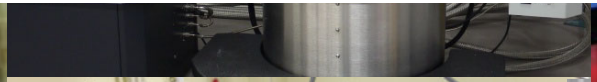
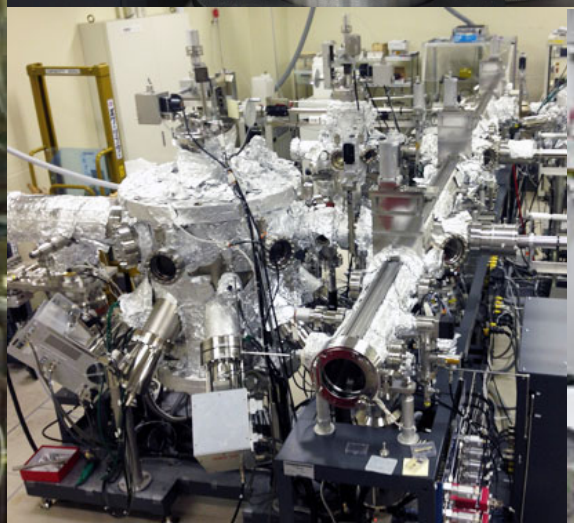
Prof. Shinji Yuasa /AIST

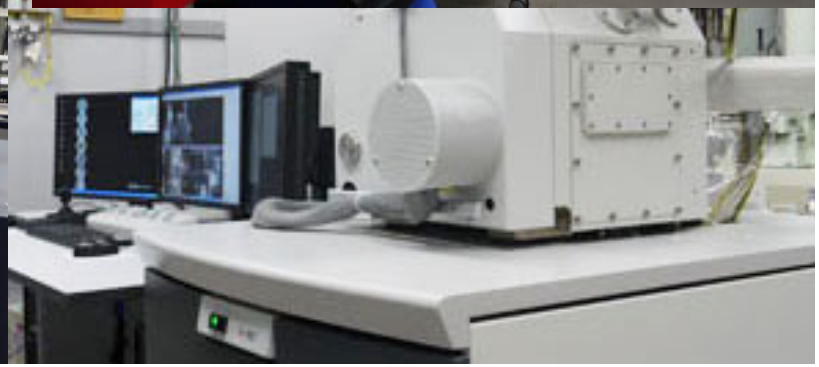
Nature Commu. 8, 15848 (2017)
Nature 547, 428 (2017)
Nature Materials 13, 360 (2014)
Nature Materials 13, 50 (2014)
Nature Physics 8, 491 (2012)
Nature Physics 7, 626 (2011)
Nature 475, 82 (2011)
Nature Commu. 1, 8 (2010)
Nature Physics 4, 803 (2008)
Nature Physics 4, 37 (2008)
Nature 438, 339 (2005)
Nature Materials 3, 868 (2004)
Science 297, 234 (2002)

H-index = 56

Students can use state-of-the-art facility
in NIMS and AIST located near UT.
Also they provide scholarships

Company observes the growth of students

Career Paths & Donation

Networking among students, professors, and industry people

Research seminar will be held twice a year, where industry people observes the growth of students.

After the seminar, a social gathering will be held with company people to communicate.

Elite students grow, who understand Japanese mind.

Partnerships with South East Asia