Bio-Nano Electronics Research Centre

Interdisciplinary New Science
Fusion of Bioscience and Nanotechnology

Bio-Nano Electronics Research Centre
Toyo University

2100, Kujirai, Kawagoe, Saitama 350-8585, Japan
Tel: +81 49 239 1375
E-mail: bnel@toyo.jp
URLs: http://bionano.toyo.ac.jp/COEtop.htm
https://www.toyo.ac.jp/en/research/labo-center/bnel/

Preface

The Bio-Nano Electronics Research Centre was established in 1996 to carry out (a) advanced research on nanoscience/nanotechnology, bioscience/biotechnology and bio-nano science and technology, (b) educate both graduate and undergraduate students via advanced research and (c) promote and accelerate international academic activities.

We have focused, in particular, on bio-nano fusion research as well as individual studies of bioscience and nanotechnology and the expansion of academic collaboration with other overseas research institutions so that the Bio-Nano Electronics Research Centre, Toyo University, becomes a “Research and Educational Centre” in the field of interdisciplinary new science in the world.

We briefly summarised in this pamphlet what we have done for the development of “Global Bio-Nano Innovation Programmes”.

We hope you’ll enjoy reading about it.

Toru Maekawa

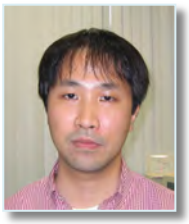
Director
Bio-Nano Electronics Research Centre
Toyo University

Deputy-Directors

Nanotechnology
Facilities & equipment
Tatsuro Hanajiri

Biotechnology
Noriyuki Doukyu

Bio-nano fusion technology
Sakthi Kumar



Bio-nano fusion science
Hisao Morimoto

Coordinators for international and academia-industry collaboration

Sujun Guan

Tianzhuo Zhan

Taira Kajisa

Toru Mizuki

Secretariat

Tetsuya Negishi

Shunsuke Kasuya

Ayako Hoshi

Masanobu Makino

Minako Hardy

Terumi Kanada

1. Bio-Nano Electronics Research Centre

The Bio-Nano Electronics Research Centre was established in 1996 in order to conduct advanced combined studies on bioscience and nanotechnology for the investigation of fundamental biotic functions and mechanisms and for the development of nano/micro bio analysis sensors and devices. The Centre's research and educational activities were supported by mainly the Grants for High-Tech Research Centres Programme (1996-2000 (Phase I); 2001-2005 (Phase II); 2006-2010 (Phase III)), 21st Century's Centre of Excellence (COE) Programme (2003-2007) and Strategic Research Foundation at Private Universities Programmes (2011-2015) organised by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The governmental funds for individual research groups at private universities having been completely abolished, the Centre's activities have been supported by Toyo University since 2016. The research carried out at the Bio-Nano Electronics Research Centre is classified into the following four main fields:

(a) Fundamental science related to nanotechnology, biotechnology and bio-nano fusion technology
(b) Development of highly efficient nano-electron devices
(c) Application of fundamental bioscience to bio-nano technology
(d) Development of nano/micro bio-medical sensors, devices and methodologies

A new building, which is named "Bio-Nano Annex: *Beta*" was opened in March 2013. State-of-the-art facilities and equipment such as transmission electron microscopes (TEMs), scanning electron microscopes (SEMs), scanning probe microscopes (SPMs) and all sorts of spectroscopic analysers are installed in the Annex *Beta*;

Ground floor
Large scale equipment (TEMs, SEMs, SPMs, AES, XPS, TOF-SIMS, SQUID, VSM etc.)
First floor
Centre office; Common space; Young researchers' room; Spectroscopic analysers (MALDI-TOF MS, Micro Raman, XPS, FTIR, TGA, Porosimeter, NIPL, XRD, etc.)
Second floor
Bio-nano fusion laboratories; Cell laboratory; Bacterial laboratory; Cell cultivation and preservation rooms; Laser confocal microscopes; Laser generators; Spectroscopic analysers etc.
Third floor
International seminar hall; Academia-industry collaborative rooms; International collaboration office; International intellectual properties office; Academia-industry common room; Seminar rooms; etc.

The original building, which is named "*Alpha*", was opened in October 1997. Both nanotechnology super clean rooms and biotechnology clean rooms are installed, respectively on the ground and first floors. Academia-industry collaborative laboratories are also provided with on the first floor.

Ground floor
Technical Managers' office
Nanotechnology super clean rooms (Class: 100, 1000, 10000)
First floor
Biotechnology clean rooms
Academia-industry collaborative laboratories

Original building: *Alpha*

Bio-Nano Annex: *Beta*

Bio-Nano Electronics Research Centre

2. Brief history

1996 Establishment of the Bio-Nano Electronics Research Centre
Selected as a High-Tech Research Centre (Phase I), MEXT (1996 - 2000)
1999 Grant for a New Technology Development, MEXT (1999 - 2000)
2001 Selected as a High-Tech Research Centre (Phase II), MEXT (2001 - 2005)
Award for Eminent Scientists (Sir Harry Kroto, 1996 Nobel laureate), JSPS (2001 - 2003)
2003 Selected as a 21st Century's Centre of Excellence, MEXT (2003 - 2007)
2004 Award for Eminent Scientists (Sir John Walker, 1997 Nobel laureate), JSPS (2004 - 2006)
2006 Selected as a High-Tech Research Centre (Phase III), MEXT (2006 - 2010)
2007 Selected as a Nanotechnology Innovation Support Centre, MEXT (2007 - 2011)
Establishment of the Graduate School of Interdisciplinary New Science (Doctoral Course)
Research and Educational Collaboration Agreement with the following institutions:
School of Pharmacy and Biomolecular Sciences, University of Brighton, UK
Institute for Collaborative Biotechnologies, University of California Santa Barbara, USA
Unité de Formation et Recherche, Université Pierre et Marie Curie (Paris 6), France
Department of Chemistry, Department of Mathematics, University of Montana, USA
JEOL Ltd., Japan
Asylum Technology Co. Ltd., Japan
Asylum Research, USA
2008 Research and Educational Collaboration Agreement with the following institutions:
Nicole Grobert's Research Group, Department of Materials, University of Oxford, UK
Shimadzu Co., Japan
2009 Research and Educational Collaboration Agreement with the following institution:
Indian Institute of Technology Delhi, India
2011 Establishment of the Master Course at the Graduate School of Interdisciplinary New Science
Grant for the Programme for the Strategic Research Foundation at Private Universities, MEXT (2011 - 2015)
Research and Educational Collaboration Agreement with the following institutions:
IC Design Research and Education Centre, Vietnam National University – Ho Chi Minh City, Ho Chi Minh, Vietnam
Centre for Fundamental and Advanced Technical Research, Romanian Academy, Timisoara, Romania
National Centre for Engineering of Systems with Complex Fluids, "Politehnica" University of Timisoara, Timisoara, Romania
Laboratory for Engineering and Applications of Nanomaterials, Rice University, USA
2012 Research and Educational Collaboration Agreement with the following institutions:
Department of Physical Chemistry and Materials Science, Budapest University of Technology and Economics, Hungary
University of Brighton, UK
Université de Nantes, France (PhD Double Degree Programme)
Horiba Ltd., Japan
Hitachi High-Technologies Co., Japan
Elionix Inc., Japan
Samco Inc., Japan
2013 Research and Educational Collaboration Agreement with the following institutions:
Nano Research Facility, Indian Institute of Technology Delhi, India (BN Centre's office)
Université Pierre et Marie Curie (Paris 6), France (PhD Double Degree Programme)
2014 Research and Educational Collaboration Agreement with the following institutions:
National Institute of Materials Physics, Romania
Dept. Metallic Materials Science and Physical Metallurgy, University Politehnica of Bucharest, Romania
Sultan Qaboos University, Oman
Nissan ARC Ltd., Japan
2015 Research and Educational Collaboration Agreement with the following institutions:
Sree Chitra Tirunal Institute for Medical Sciences and Technology, India
Istituto Italiano di Tecnologia, Italy
Oxford Instruments KK, Japan
Oxford Instruments Asylum Research Inc., USA
2016 Research and Educational Collaboration Agreement with the following institution:
Universiti Teknologi Malaysia, Malaysia
2017 Erasmus+ Programme with Politehnica University of Timisoara, Romania
2018 Research and Educational Collaboration Agreement with the following institution:
Sorbonne Université, France (PhD Double Degree Programme)

3. Management

The Research Support Office was opened in 2003 and reformed as the Research Promotion Section in 2015 for the smooth operation of the research and educational programmes. Six members deal with a variety of administrative tasks, among which are (a) the organisation of international academic programmes such as research and educational collaboration and exchange of researchers and students, (b) the organisation of international symposia and seminars, (c) the creation and distribution of websites, pamphlets and research reports, and (d) the management and maintenance of facilities and equipment. The Centre Committee, which is composed of the Director, four Deputy-Directors and three Coordinators, decides and directs all the matters related to the research and educational programmes in cooperation with the Research Promotion Section.

4. Education

The "Graduate School of Interdisciplinary New Science", was established in April 2007 based on the "21st Century's Centre of Excellence Programme". This new doctoral school accepts motivated students from all over the world, and educates and creates advanced researchers in the fields of bioscience/biotechnology, nanoscience/nanotechnology and bio-nano fusion science/technology in collaboration with advanced visiting professors. The master course was opened in April 2011. This course provides the master students with "Workshops on Advanced Equipment" and "Web Educational Programmes" as well as advanced Lectures and Master Research Courses. We also started trans-departmental minor course; "Bio-Nano Science Fusion Course", for undergraduate students in 2007.

5. Global Educational Outreach for Science, Engineering and Technology (GEOSET)

We are developing Web educational programmes called "GEOSET Toyo" in collaboration with Dr Steve Acquah, University of Massachusetts, Amherst, USA. We distribute lectures, seminars, experiments, workshops, interviews, etc. for primary, junior high and high school students and their teachers, undergraduate and graduate students and researchers.

6. Nanotechnology Support Programme

Our Centre has nanoelectronics super clean rooms (Class: 100, 1000, 10000) and biotechnology clean rooms and has introduced high-tech equipment regularly for conducting advanced research and education following our short- and intermediate-term strategies. As a result, our Centre was selected as a Nanotechnology Support Centre in 2007 by MEXT. Our facilities and equipment are open to researchers from other universities and industries.

7. International activities

Our Centre and Graduate School have organised and held international symposia, seminars and workshops at overseas institutions and the Kawagoe Campus, thanks to which we have exchanged academic agreements with quite a few universities and companies for the development of collaborative research and educational programmes.


Nanostructures Processing Room

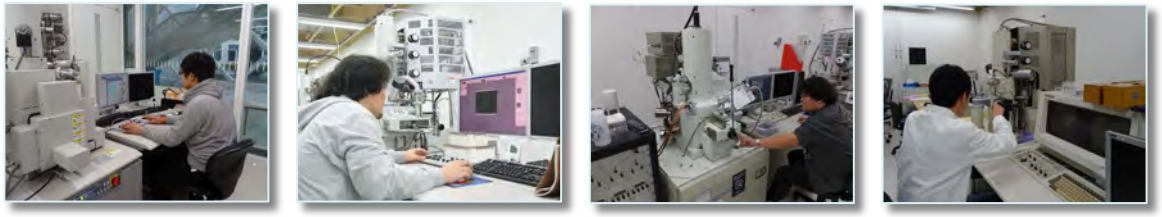

Electron Beam Lithography System


Sputtering System


Deep Reactive Ion Etching Machine

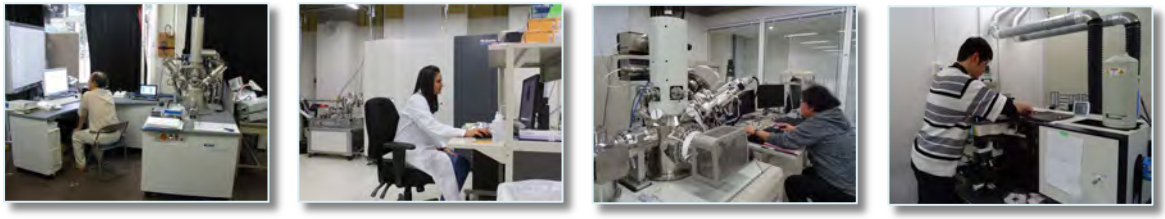
Nanotechnology Clean Rooms
Bio-Nano Electronics Research Centre: *Alpha*

Transmission Electron Microscopes



Scanning Electron Microscopes

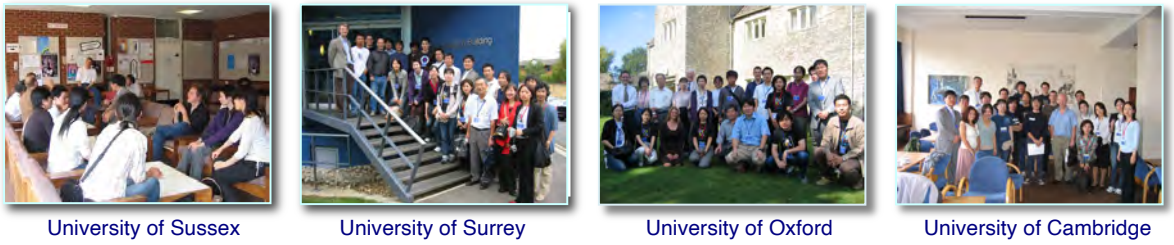
Scanning Probe Microscopes | Spectral Confocal Microscopes | MALDI-TOF MS | SQUID



TOF SIMS | XPS (Hard X-ray) | AES | Laser Raman Spectroscopy System

Facilities and equipment
Bio-Nano Electronics Research Centre Annex: *Beta*

International Symposium on Bioscience and Nanotechnology
International Seminar Hall, Bio-Nano Electronics Research Centre Annex: *Beta*



University of Sussex | University of Surrey | University of Oxford | University of Cambridge

University Pierre and Marie Curie | University Paris Diderot | University of Brighton | Queen Mary College


National Physical Laboratory


University of California Santa Barbara

Asylum Research


Indian Institute of Technology Delhi

International Seminars at overseas institutions

8. Recent publications

P. Muniyandi, V. Palaninathan, T. Mizuki, M.S. Mohamed, T. Hanajiri and T. Maekawa, Scaffold mediated delivery of dual miRNAs to transdifferentiate cardiac fibroblasts, *Mater. Sci. Eng. C* **128**, 112323 (2021).
DOI: 10.1016/j.msec.2021.112323

N. Doukyu and K. Taguchi, Involvement of catalase and superoxide dismutase in hydrophobic organic solvent tolerance of Escherichia coli, *AMB Express* **11**, 97 (2021).
DOI: 10.1186/s13568-021-01258-w

H. Shimoshige, H. Kobayashi, S. Shimamura, T. Mizuki, A. Inoue and T. Maekawa, Isolation and cultivation of a novel sulfate-reducing magnetotactic bacterium belonging to the genus *Desulfovibrio*, *PLoS ONE* **16**, e0248313 (2021).
DOI: 10.1371/journal.pone.0248313

H. Takei, K. Nagata, N. Frese, A. Golzhauser and T. Okamoto, Surface-enhanced Raman spectroscopy for molecule characterization: HIM investigation into sources of SERS activity of silver-coated butterfly scales, *Nanomaterials* 11, 1741 (2021).
DOI: 10.3390/nano11071741

S. Agarwal and T. Maekawa, Nano delivery of natural substances as prospective autophagy modulators in glioblastoma, *Nanomedicine* **29**, 102270 (2020).
DOI: 10.1016/j.nano.2020.102270

A. Dager, A. Baliyan, S. Kurosu, T. Maekawa and M. Tachibana, Ultrafast synthesis of carbon quantum dots from fenugreek seeds using microwave plasma enhanced decomposition: application of C-QDs to grow fluorescent protein crystals, *Sci. Rep.* **10**, 12333 (2020).
DOI: 10.1038/s41598-020-69264-9

G. Mary, A.V. Walle, J.E. Perez, T. Ukai, T. Maekawa, N. Luciani and C. Wilhelm, High-throughput differentiation of embryonic stem cells into cardiomyocytes with a microfabricated magnetic pattern and cyclic stimulation, *Adv. Funct. Mater.* (2020).
DOI: 10.1002/adfm.202002541

T. Ukai, J. Dong, T. Maekawa and H. Morimoto, Nonequilibrium cluster structures formed in a thin magnetorheological fluid layer subjected to a dc magnetic field, *AIP Adv.* **10**, 055012 (2020).
DOI: 10.1063/1.5144574

P. Muniyandi, V. Palaninathan, T. Mizuki, T. Maekawa, T. Hanajiri and M.S. Mohamed, Poly (lactic-co-glycolic acid)/polyethylenimine nanocarriers for direct genetic reprogramming of microRNA targeting cardiac fibroblasts, *ACS Appl. Nano Mater.* **3**, 2491–2505 (2020).
DOI: 10.1021/acsanm.9b02586

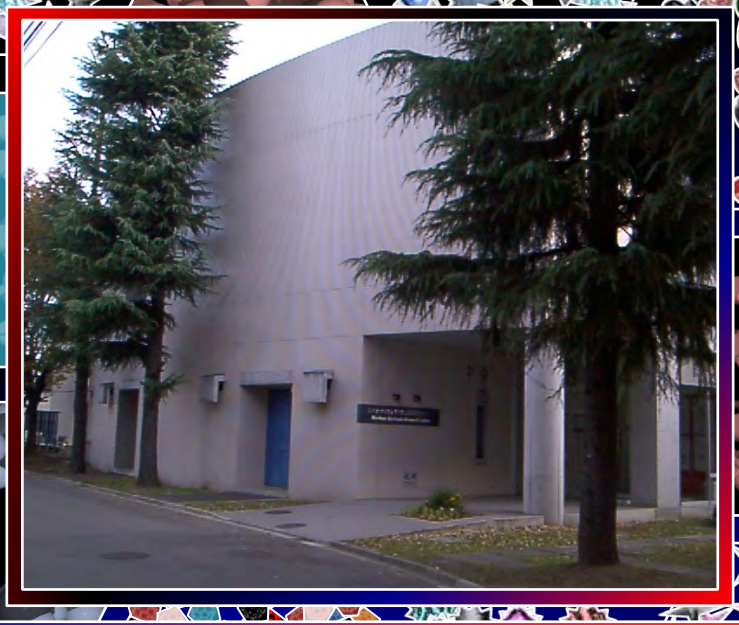
P. Muniyandi, V. Palaninanthan, S. Veeranarayanan, .T. Ukai, T. Maekawa, T. Hanajiri, M.S. Mohamed, ECM mimetic electrospun porous poly (L-lactic acid) (PLLA) scaffolds as potential substrates for cardiac tissue engineering, *Polymers* **12**, 451 (2020).
DOI: 10.3390/polym12020451

N. Doukyu and M. Ishikawa, **C**holesterol oxidase from Rhodococcus erythropolis with high specificity toward beta-cholestanol and pytosterols, *PLoS ONE* **15**, e0241126 (2020).
DOI: 10.1371/journal.pone.0241126

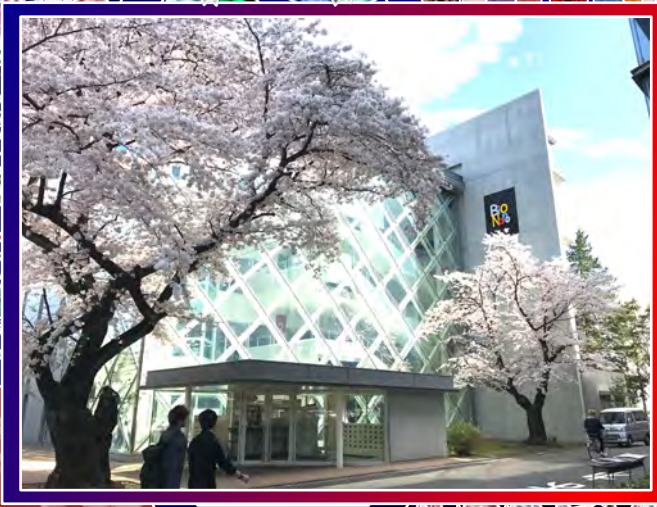
Y. Usui, T. Shimizu, A. Nakamura and M. Ito, Metabolites produced by *Kaistiasp. 32K* promote biofilm formation in coculture with *Methylobacteriumsp. ME121*, *Biology*-Basel **9**, 287 (2020).
DOI: 10.3390/biology9090287

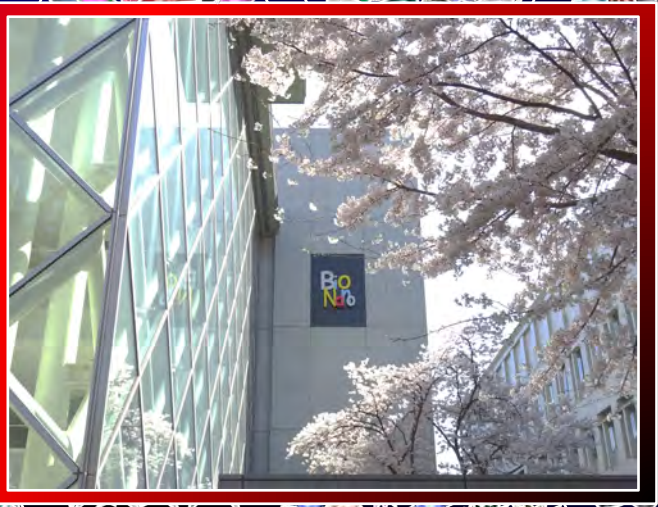
S. Nagasawa and M. Ito, MotP subunit is critical for Ion selectivity and evolution of a K+-coupled flagellar motor, *Biomolecules* **10**, 691 (2020).
DOI: 10.3390/biom10050691

U. Yamaguchi, M. Ogawa and H. Takei, Patterned superhydrophobic SERS substrates for sample pre-concentration and demonstration of its utility through monitoring of inhibitory effects of paraoxon and carbaryl on AchE, *Molecules* **25**, 2223 (2020).
DOI: 10.3390/molecules25092223



Bio-Nano Electronics Research Centre: Alpha





Bio-Nano Electronics Research Centre: Annex Beta