Research area of Creation of Innovative Coating Technologies

Thursday, November 24, 2020

University of Tokyo
Nippon Paint Holdings Co., Ltd.

THE UNIVERSITY OF TOKYO × NIPPON PAINT HOLDINGS CO., LTD.

Industry-Academia Co-creation Agreement between the University of Tokyo and Nippon Paint Holdings

Starting with the two presidents' shared mutual trust

Agreement signed on May 18, 2020

THE UNIVERSITY OF TOKYO × NIPPON PAINT HOLDINGS CO., LTD.

Nippon Paint-University of Tokyo Laboratory and Social Cooperation Course

SUSTAINABLE DEVELOPMENT GOALS

Contribute to Smart/Remote Society	Environmental Burden/Social Cost Control	Infectious Disease Risk Reduction

Academic representative
WAKIHARA Toru

Social Cooperation Course "Creation of Innovative Coating Technologies"

Course name	Creation of Innovative Coating Technologies
Period	October 1, 2020 – September 30, 2025 (five years)
Funding	1 billion yen

Professors Appointed for the Social Cooperation Course

Social Cooperation Course “Creation of Innovative Coating Technologies”

Contribute to Smart / Remote Society

KAWAHARA Yoshihiro
Project Professor

ICHIKI Takanori
Project Professor

Environmental Burden / Social Cost Control

SHIOMI Junichiro
Project Professor

SAKAI Keiji
Project Professor

Infectious Disease Risk Reduction

TSUMOTO Kohei
Project Professor

YAMAGUCHI Kazuya
Project Professor

TATSUMA Tetsu
Project Professor

WAKIHARA Toru
Project Professor
(Academic representative)

School of Engineering | Institute of Industrial Science

Institute for Future Initiatives | Institute of Medical Science

THE UNIVERSITY OF TOKYO × NIPPON PAINT HOLDINGS CO., LTD.

Creation of Innovative Coating Technologies

Coating Technologies for a Smart / Remote Society

Designing with an unlimited palette of colors

Ensuring urban comfort and safety

Coating Technologies for a Smart / Remote Society

Prof. KAWAHARA Yoshihiro

Specialization : Ubiquitous computing, wireless power transmission

Research projects
at the University of Tokyo (Prof. Kawahara)

Liquid Pouch Motor

https://www.akg.t.u-tokyo.ac.jp/archives/1281

Liquid pouch motors generate driving power when the liquid in the small pouch is heated and evaporates, thus inflating the structure. With thin and flexible heaters and sensors printed with conductive ink, the laboratory has developed motors fully made up of flexible components. For their soft and thin properties, liquid pouch motors can be applied as soft robot actuators.

Multimode Quasistatic Cavity Resonators for 3D Wireless Power Transfer

https://www.akg.t.u-tokyo.ac.jp/archives/2334

The laboratory developed a wireless power transmission system using multimode quasistatic cavity resonators (multimode QSCRs) and demonstrated the system's full-range performance in a 3 m x 3 m room. The installation of power transmitters in the walls and floor generates an AC magnetic field with a 3D distribution, eliminating the need to install a conductive pole or any other structure in the middle of the room as in the conventional method. The system can transmit power in the order of dozens of watts over a broad range.

Coating Technologies for Environmental Burden / Social Cost Control

Lively and healthy urban centers

Comfortable and pleasant environment

Coating Technologies for Environmental Burden / Social Cost Control

Prof. SHIOMI Junichiro

Specialization: Molecular thermal engineering

Prof. ICHIKI Takanori

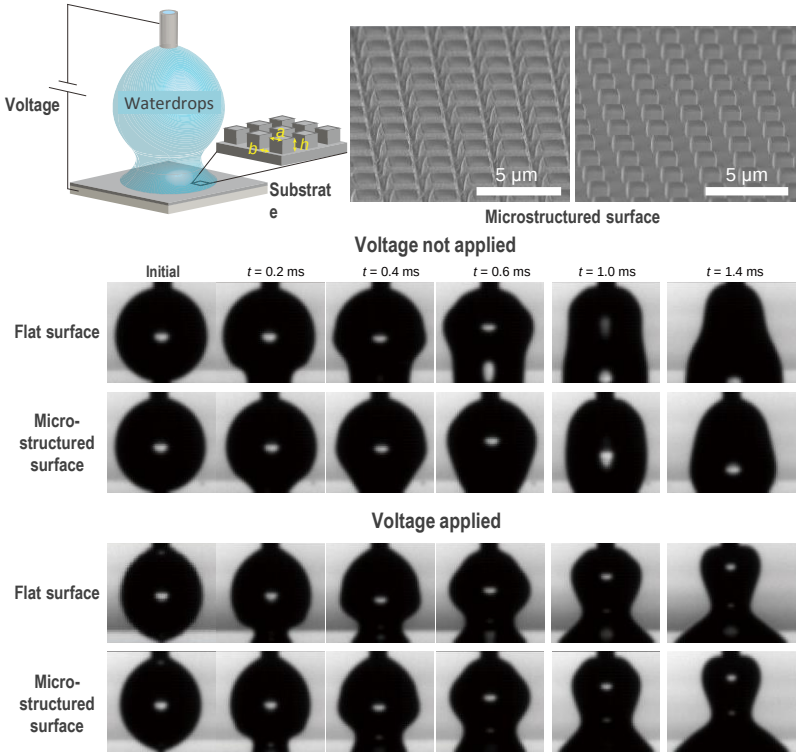
Specialization: Nanotechnology, materials engineering

Prof. SAKAI Keiji

Specialization: Nanorheology

Research projects at the University of Tokyo (Prof. Shiomi)

Control of dynamic wetting by surface control



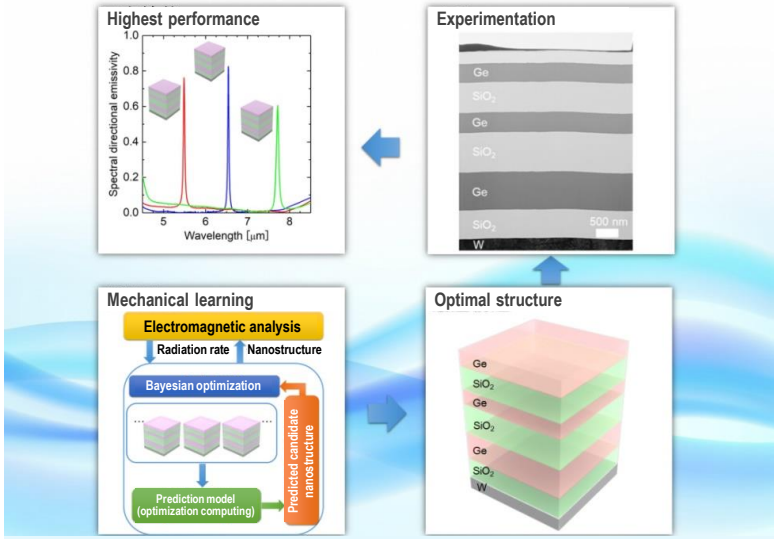
Electrostatic control of wetting behavior

(Voltage cancels the impact of the microstructured surface.)

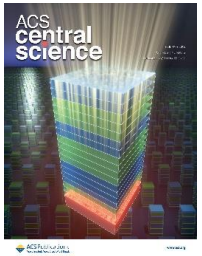
Science Advances 3, e1602202 (2017)

Control of thermal radiation with optimal metamaterials (materials informatics)

Development of high-performance thermal radiative metamaterials by machine learning



Fusion of machine learning using Bayesian optimization and electromagnetic analysis



ACS Central Science 5, 319 (2019)

Coating Technologies for Infectious Disease Risk Reduction

Safety and security in all daily situations

Coating Technologies for Infectious Disease Risk Reduction

Prof. TSUMOTO Kohei

Specialization: Chemical bioengineering

Prof. TATSUMA Tetsu

Specialization: High-performance electrical chemical devices

Prof. YAMAGUCHI Kazuya

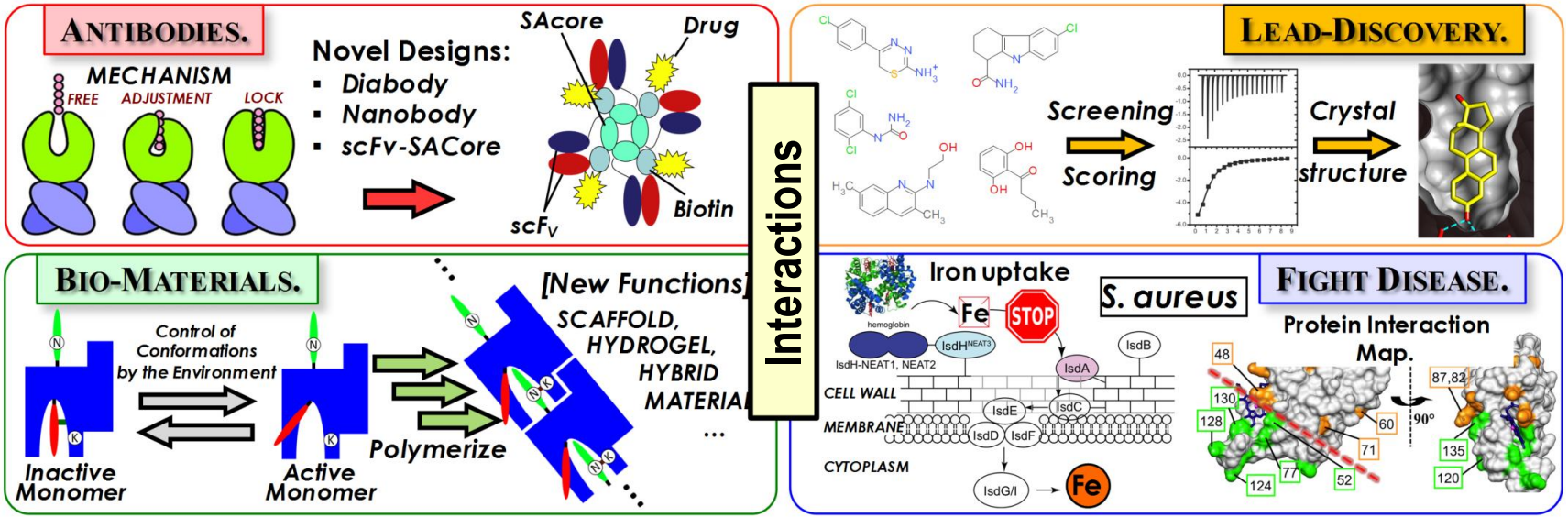
Specialization: Catalytic chemistry

Prof. WAKIHARA Toru

Specialization: Chemical engineering, ceramic processing

Research projects
at the University of Tokyo (Prof. Tsumoto)

Life phenomena are composed of highly organized specific intermolecular interactions. In this laboratory, we analyze the essential nature of these specific interactions, using various methods. We also screen and design compounds that are artificially manipulable and explore engineering approaches to the development of biopharmaceuticals for the age of "bio-better" drugs. Moreover, we elucidate the molecular machinery of disease-related proteins from multiple angles so as to build a foundation for drug discovery.

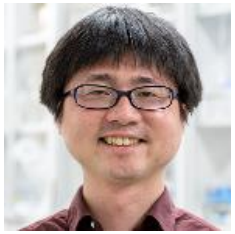


Innovative Coating Technologies
Demonstration of efficacy against the novel coronavirus

The School of Engineering and the Institute of Medical Science of the University of Tokyo have decided to jointly pursue a project to demonstrate the efficacy of visible-light-responsive photocatalysis and other innovative coating technologies against the novel coronavirus (SARS-CoV-2) in realistic situations within the framework of R&D for infectious disease risk reduction as part of the Social Cooperation Course "Creation of Innovative Coating Technologies." This project aims at serving society by enhancing people's safety and security in actual situations in the near future.

Graduate School of Engineering

Department of Bioengineering



Assistant Prof. NAKAKIDO Makoto

Prof. TSUMOTO Kohei

Institute of Medical Science

Division of Viral Infection, Department of Infectious Disease Control, International Research Center for Infectious Diseases

Associate Prof. ICHINOHE Takeshi

Step 1
Screening by protein denaturation

Step 2
Verification of efficacy by phage assay

Step 3
Verification of efficacy against animal viruses (BSL-2)

Step 4
Verification of efficacy against the novel coronavirus (BSL-3)

Building a Sustainable Society and a Better Future

Appendix: Research Projects by the Professors

Prof. TATSUMA Tetsu

Specialization:
High-performance electrical chemical devices

Prof. YAMAGUCHI Kazuya

Specialization: Catalytic chemistry

Prof. WAKIHARA Toru

Specialization: Chemical engineering, ceramic processing

Prof. ICHIKI Takanori

Specialization: Bio devices

Prof. SAKAI Keiji

Specialization: Nanorheology engineering

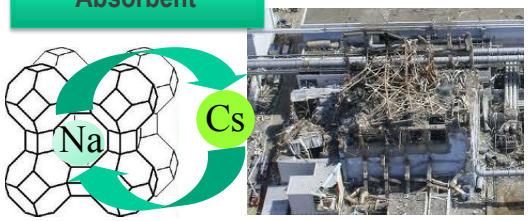
Research Projects at the University of Tokyo (Prof. Wakihara)

- Development of new methods to prepare high-performance zeolite materials
- Practical application of nanoporous materials, key materials for a sustainable society

Petrochemical catalysis

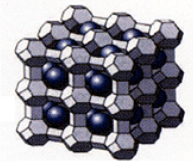
Production of plastics

Absorbent



Absorption of radioactive cesium

Antibacterial agent

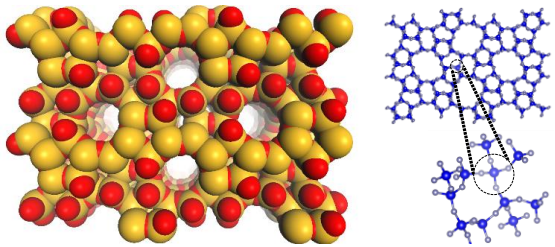


Silver zeolite

Active ingredients fixed in the pore

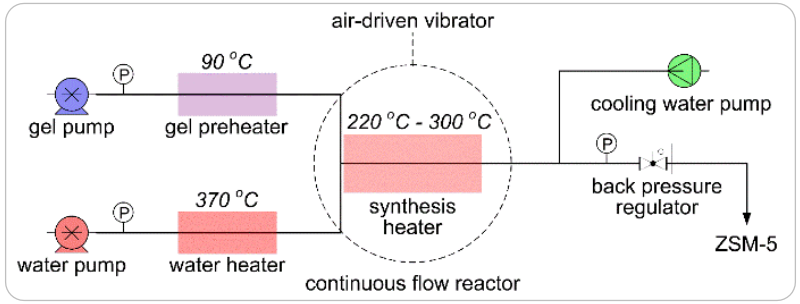
Extremely stable zeolite (JACS, ACS Catal.)

- Highest durability that overturns common sense (no degradation under steaming at/above 1000°C)
- Expected application as a catalyst or absorbent to be used under severe conditions



Continuous-flow synthesis (PNAS, Angewandte, JMCA)

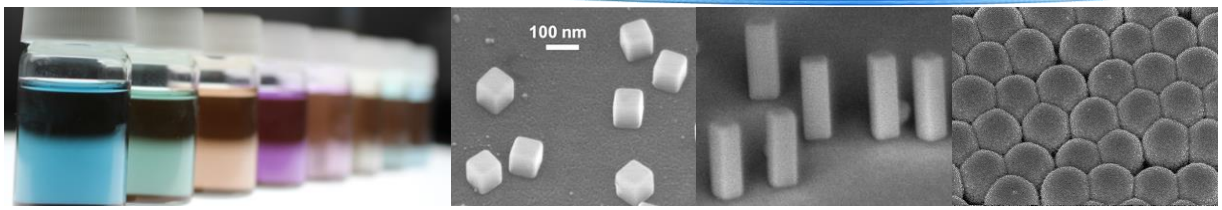
- An important switch from the conventional batch system
- Energy-saving high-efficiency synthesis

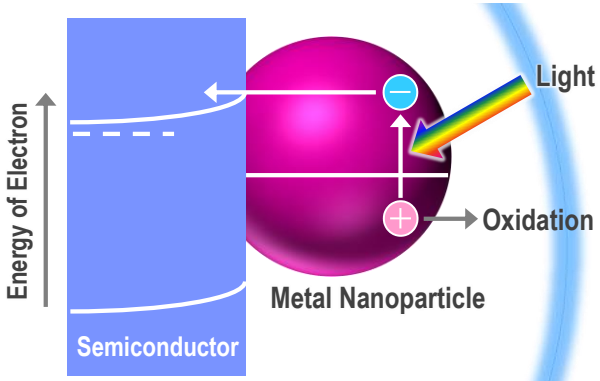


Research Projects at the University of Tokyo (Prof. Tatsuma)

Metal Nanoparticles

Effective light absorption on the basis of plasmon resonance





Plasmon-Induced Charge Separation (PICS)

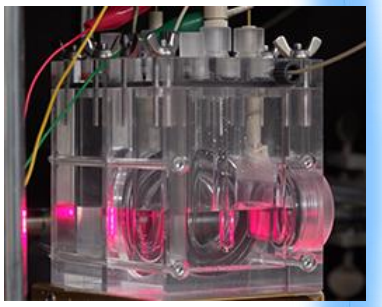
First to report PICS and elucidate its mechanism
Now widespread as plasmonic hot electron injection, a dynamic research area encompassing chemistry and physics

Photovoltaics

Energy conversion in the visible – near infrared range

Multicolor Display Material

First material that colors differently according to the wavelength of irradiated light



Photocatalysis

First plasmonic photocatalysis

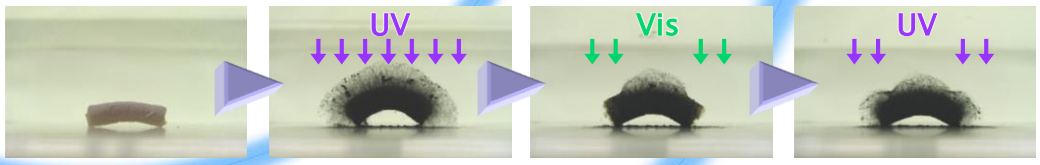
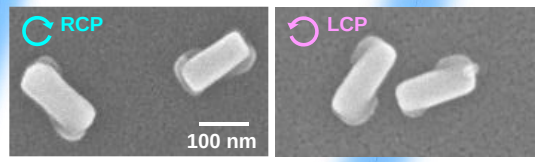


Photo-morphing Hydrogel

First hydrogel that swells and shrinks in response to light



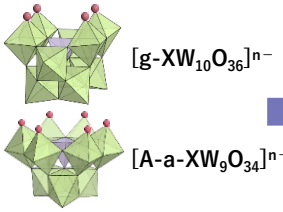
Photoinduced Nanofabrication

Fabrication beyond the diffraction limit

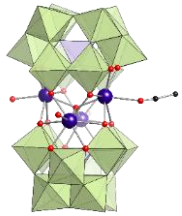
Research Projects
at the University of Tokyo (Prof. Yamaguchi)

High-performance material design by the oxide molecular template method

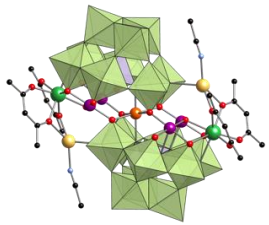
Oxide molecular template



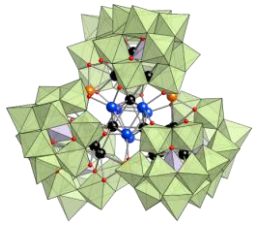
Science 2003; Angew. Chem. 2016; Chem. Eur. J. 2017; etc.



Angew. Chem. 2014



Chem. Commun. 2017



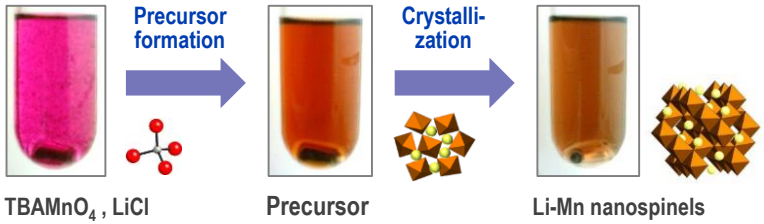
J. Am. Chem. Soc. 2019

J. Am. Chem. Soc. 2019

Designing homo/hetero-multinuclear metals, metal clusters, and organic-inorganic hybrid materials and expanding to photocatalysis and others

Synthesis of nanocrystalline oxides by reductive crystallization

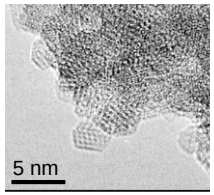
Example: Li-Mn nanospinels



$TBAMnO_4$, LiCl | Precursor | Li-Mn nanospinels

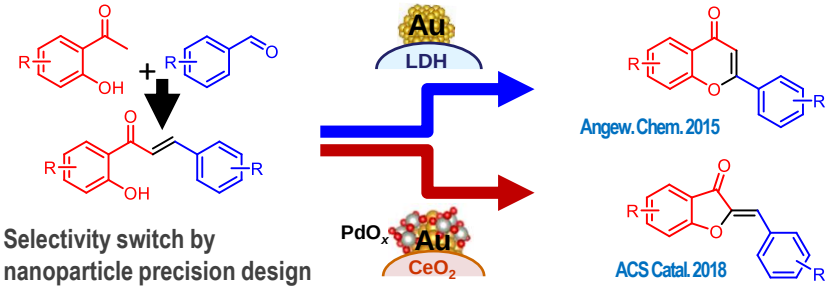
"Oxide synthesis as simple as organic synthesis"

Oxidation catalyst (organic synthesis, deodorization), ion exchange material (Li^+ collection), lithium ion battery, magnesium ion battery, etc.



Sci. Rep. 2015; ChemNanoMat 2016; etc.

Discovery of specific oxidation activity of metal nanoparticles and its application

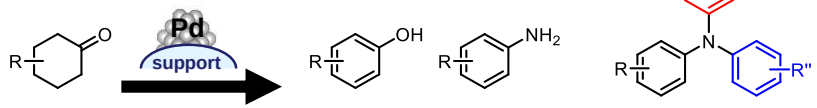


Angew. Chem. 2015

ACS Catal. 2018

Selectivity switch by nanoparticle precision design

Dehydrogenative aromatic ring formation with Pb nanoparticles



J. Am. Chem. Soc. 2017; Angew. Chem. 2019; Chem. Sci. 2020; etc.

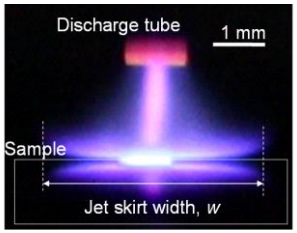
Research Projects at the University of Tokyo (Prof. Ichiki)

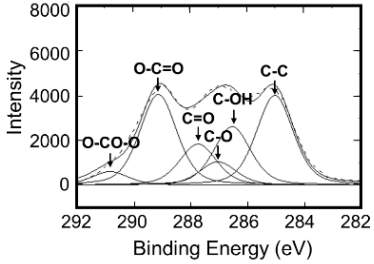
Promoting Next-Generation Paint Material Development by Integrating Materials Engineering Knowledge

Materials and nanotechnology

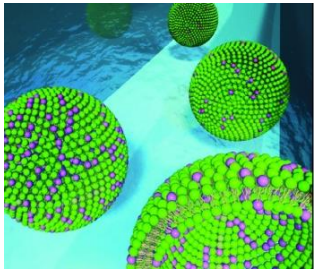
Elucidation of the mechanisms of next-generation paints based on advanced surface treatment/analysis technology and nanoparticles/colloid science (Ichiki Laboratory)

Applied surface science



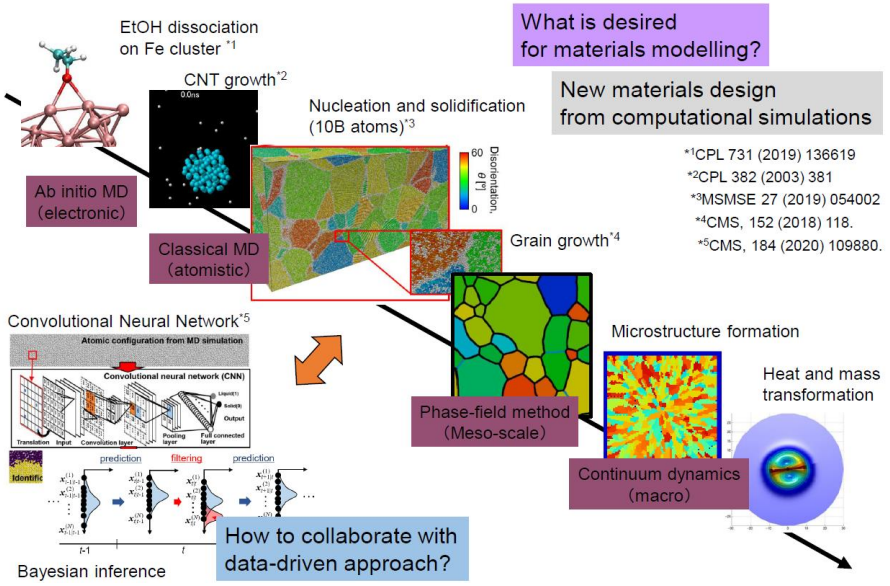


Nanoparticle/colloid science



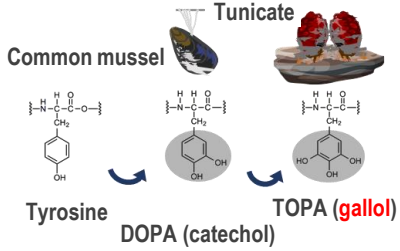
Computational materials science/Materials informatics

Acceleration of the development of novel painting materials using large-scale molecular dynamics simulations and data-driven methods (Shibuta Laboratory)



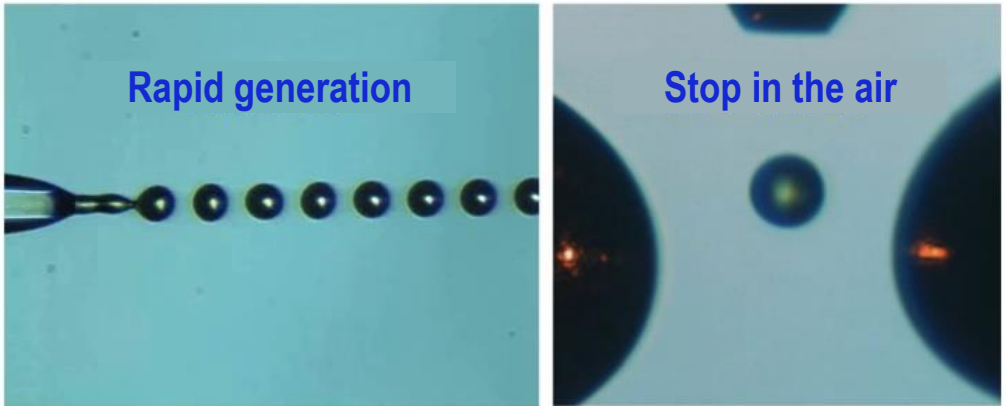
Polymer engineering

Novel underwater adhesives founded on biomimetics (Ejima Laboratory)

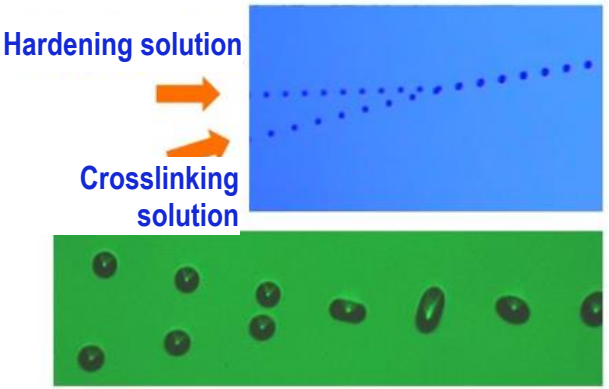


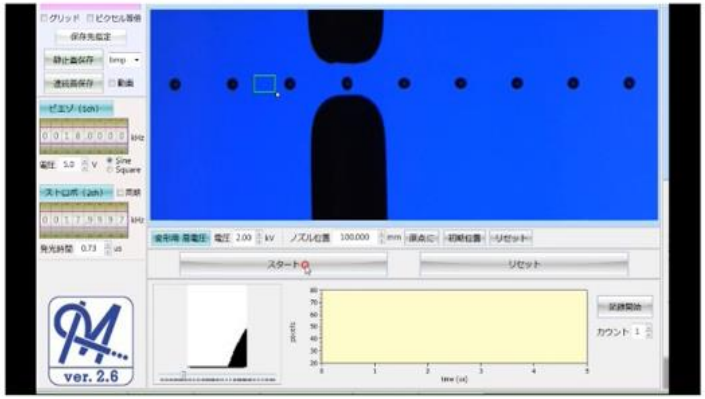
Research Projects at the University of Tokyo (Prof. Sakai)

Sakai Laboratory's picoliter handling technology

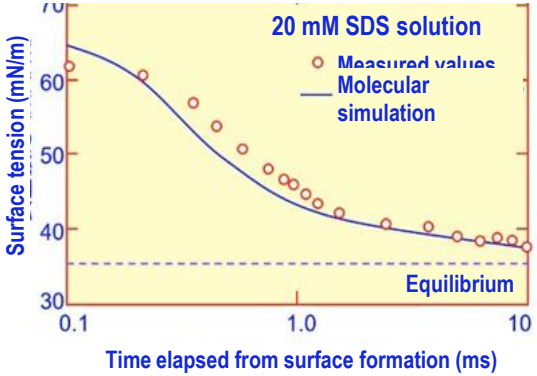


Microparticle synthesis





Dynamic absorption of surfactant molecule



Rapid measurement of surface tension change based on droplet vibration in the air