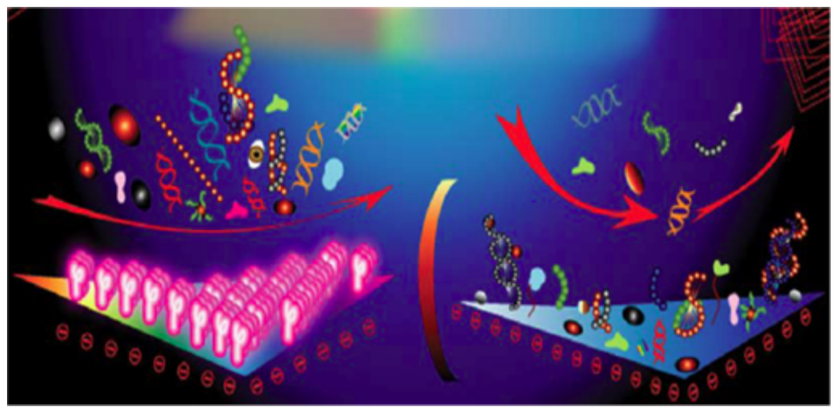
Biointerface Science Pioneers the Future Medicine

The University of Tokyo・Department of Bioengineering・TAKAI Laboratory

Biomaterial surfaces initiate the interactions with biological substances and governs the subsequent biological reactions.

It is critical to create novel biomaterials with “biocompatibility” (blood compatibility, tissue compatibility) or a specific functionality

Focus on the **“INTERFACE”** between biological substances and artificial biomaterials

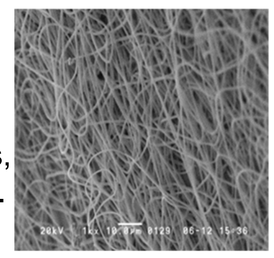


Suitable biocompatibility by controlling the chemical and physical properties of the surface nanostructures

Creation of Advanced Functional Biomaterials for Biodevices and Biosensing

Nanostructured Surface Creation via ESD

Through Electron Spray Deposition (ESD) technique, various membranes made of polymeric nanofibers were created. They are applied to accelerate and facilitate immunoassays, and also to capture circulating tumor cells (CTCs).

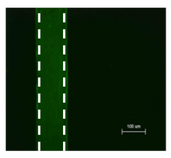


Acta Biomaterialia **67, 32–41, 2018,**
Sensing and Bio-Sensing Research **26, 00304, 2019**

Rapid immunoassays & cancer Diagnostic Devices

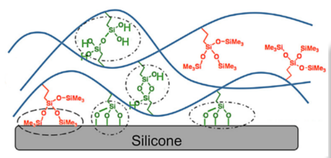
Polymer thin film to suppresses thrombus formation

We developed antithrombotic polymer modification to silicone elastomers. We aim to prolong the use of implanted device.

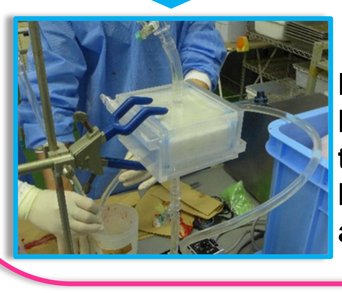


Before modification

After modification



Colloids and Surfaces B: Biointerfaces **134, 384–391, 2015**



Development of long-lasting artificial lungs through collaboration between medicine and engineering.

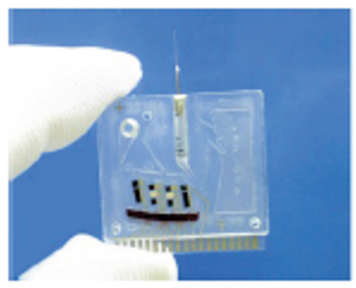
Device Production

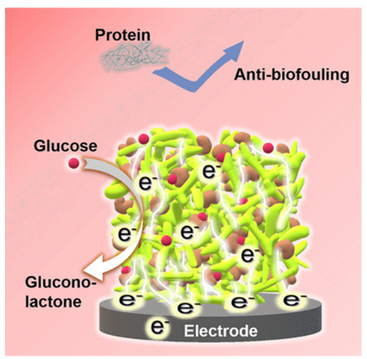
Fundamental Research Focused on the Interface

Biodevice

For the analysis of complex biological samples, it is important to have integrated microsystems that can separate and diagnose on a single chip to test multiple parameters with a single run.

Analyst, **138, 6469–6476, 2013**





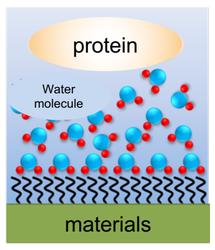
Biofuel cell

The functional hydrogel with MPC moiety can serve as an enzyme-immobilizing matrix for enzymatic bioelectrodes. The gel has potential applications as a biofuel cell that demonstrated superior operational stability.

ACS Appl. Polym. Mater., **3(2), 631–639, 2020**

Analysis of Interfacial Water Molecules

We analyze the relationship between protein adsorption and the state of water molecules at the interface.



J. Phys. Chem. C, **119, 17193-17201, 2015**

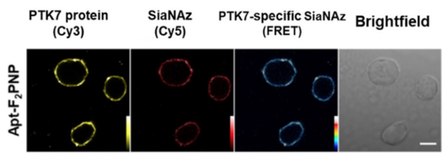
Precise Structure Control of 2D, 3D Materials for the Interfacial Function

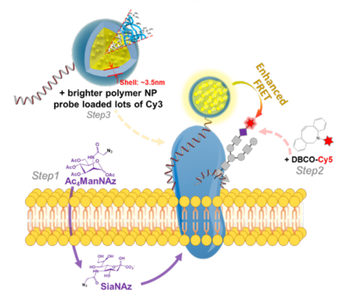
Structure of soft interfaces and gels is precisely controlled for their interfacial functions.

Polym. J., **52, 1407-1412, 2020**

Cell Imaging Using Polymeric Nanoparticle

Developed the fluorescent nanoparticles with high dye load for specific labeling the target protein.



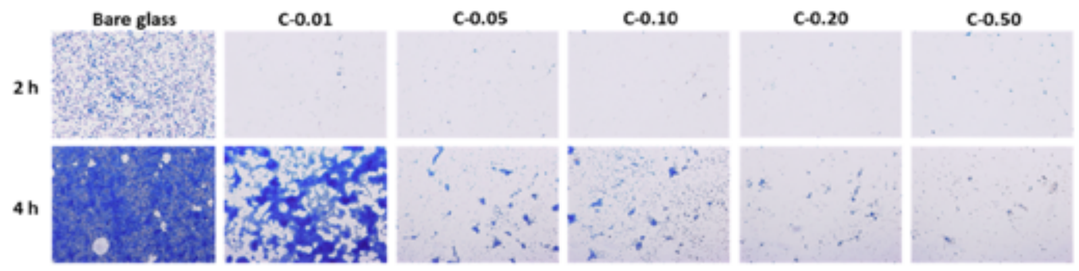


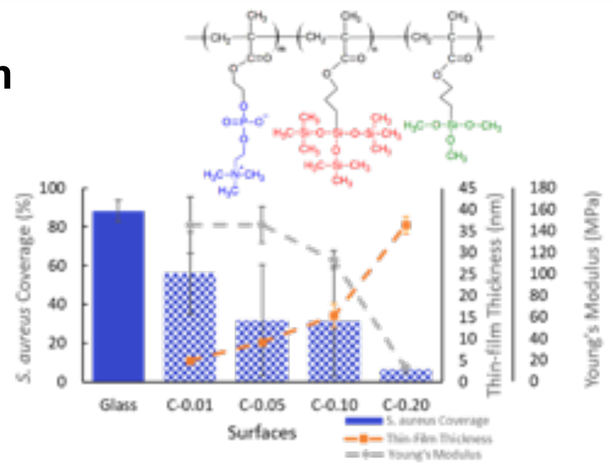
Anal. Chem., **92, 13271–13280, 2020**

the enhanced FRET imaging of protein-specific sialylation was achieved.

Nanostructure Biomaterials for Establishment of Next-Generation Cell-engineering

◎ Anti-Bacterial Adhesion on Crosslinked Polymer Thin Film

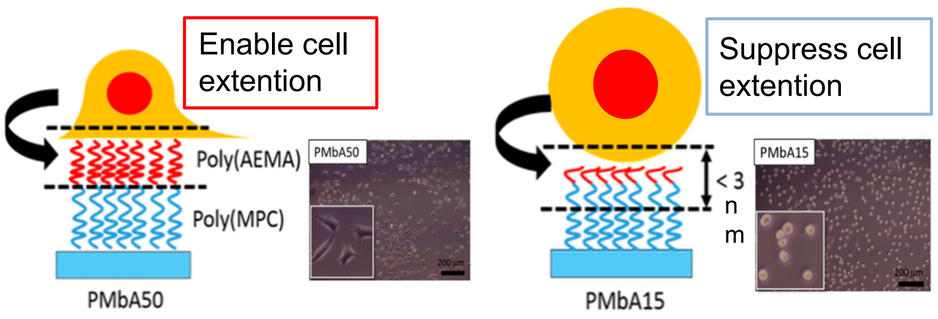




We can demonstrate anti-bacterial adhesion on the functional polymer thin film by operating thickness and physical property.

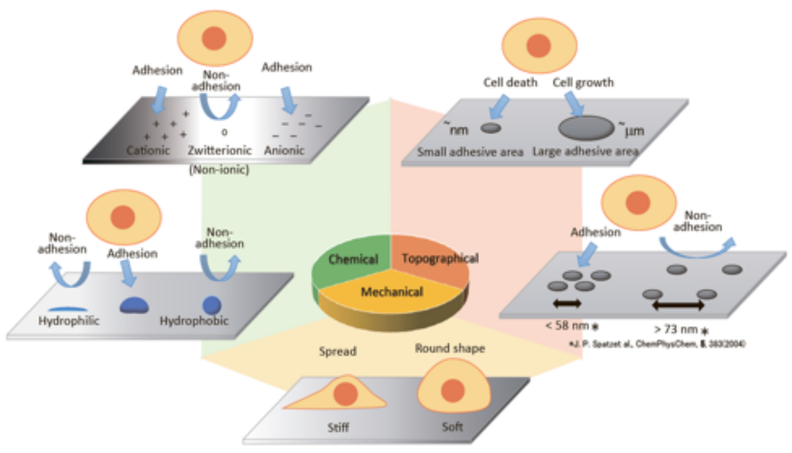
ACS Appl. Bio Mater., **3, 1079−1087, 2020**

◎ Two-layer polymer brush affects the cell adhesion behavior



ACS Appl. Mater. Interfaces, **8, 10710−10716, 2016**

Cell adhesion behavior was controlled by double layer polymer brush which contained polymers, differing in mechanical properties.



高分子　66巻, 3号, 125-129 2017

To analyze the biological behavior, it is important to understand the interaction between cells, which construct our bodies, and materials.