



OKAYAMA
UNIVERSITY

Bio-Process Engineering Group

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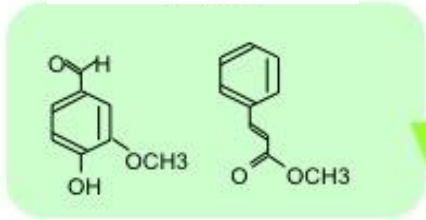
Graduate School of Natural Science and Technology
Faculty of Engineering

Main Research focus:

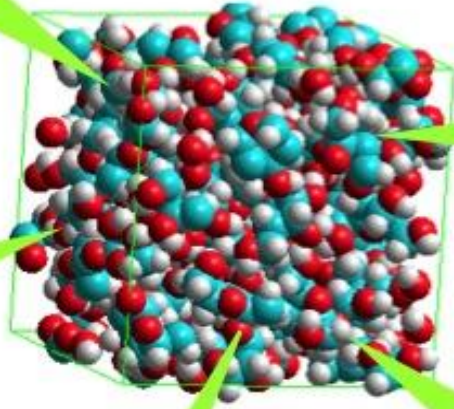
- A – **Physicochemical characteristics of proteins** stabilized by an amorphous sugar matrix (ASM)
- B – **Proteins adsorption onto metal surfaces:**
 - Controlled by application of external electric field
 - Applications to surface cleaning
- C - **Atomic force microscopy investigations of protein conformation changes:**
 - Hydrophobic interplays between bio-molecules and surfaces
- D – **Genetic engineering of proteins: immobilization techniques on functionalised surfaces**
 - Applications to tomorrow's biosensing systems
- E – **Specific designs of low-cost, versatile and eco-friendly drug delivery systems**
 - Sugar fibers as innovative drug delivery vectors

A few examples (those confidential have been omitted)

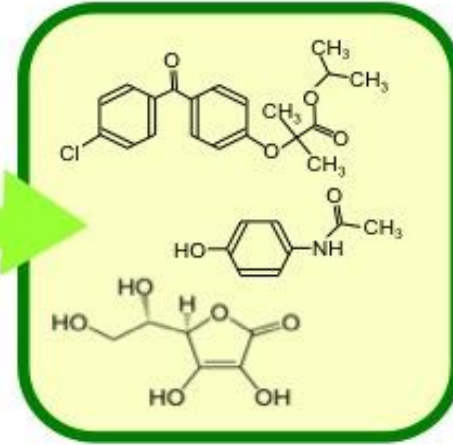
Flavours



Amorphous sugar matrix



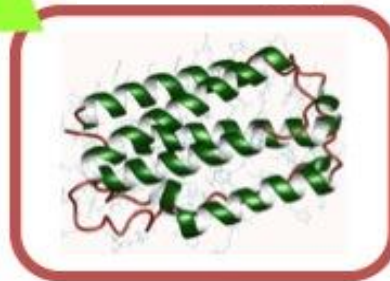
Drugs



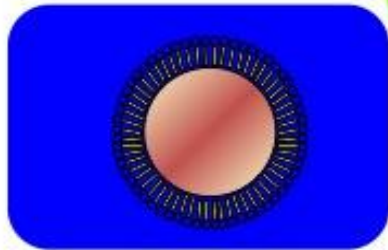
Cells



Proteins



Emulsion



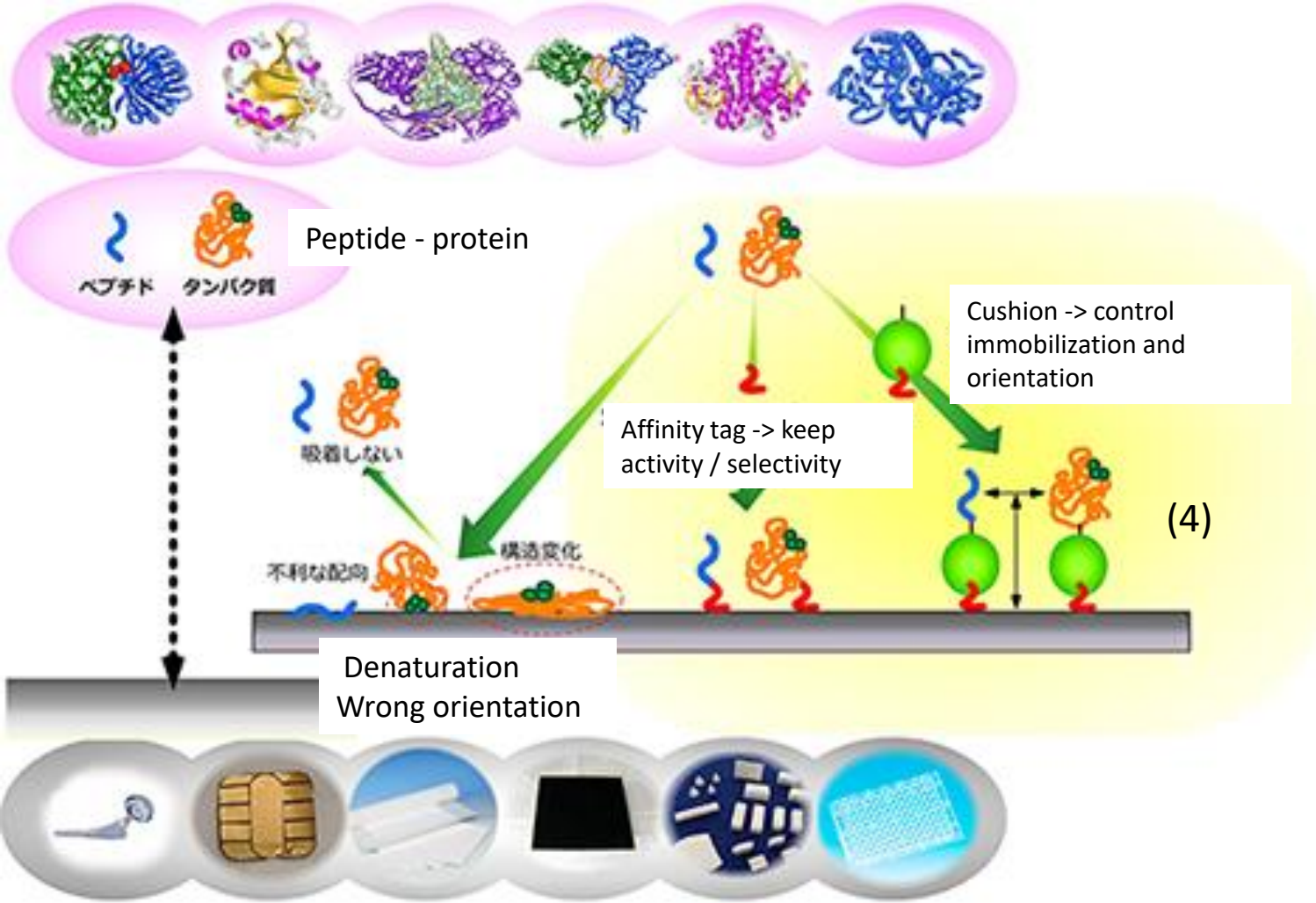
A - Research topic:

**Physicochemical characteristics of proteins stabilized by an amorphous sugar matrix (ASM)

Key feature of ASM to stabilize proteins:

- ➔ No hydration of the protein thanks to sugar (hydroxyl group)/protein interaction
- ➔ Keep protein conformation and selectivity.
- ➔ Addition of sugar surfactant may help to maximize the function of the sugar amorphous matrix and achieve superior stabilization

Advanced stabilization of proteins and enzymes.



Advanced biomolecule engineering

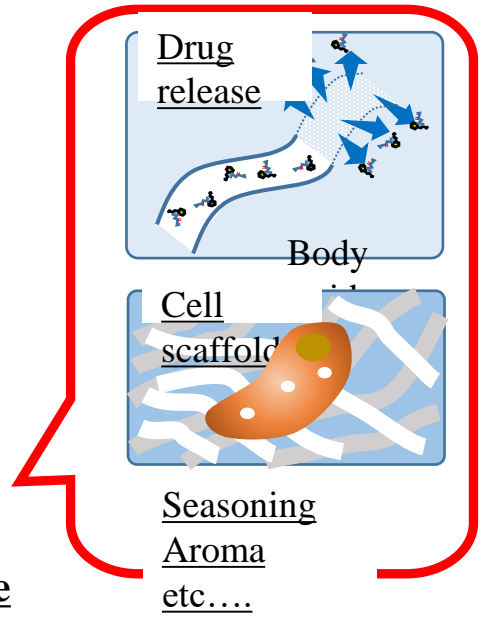
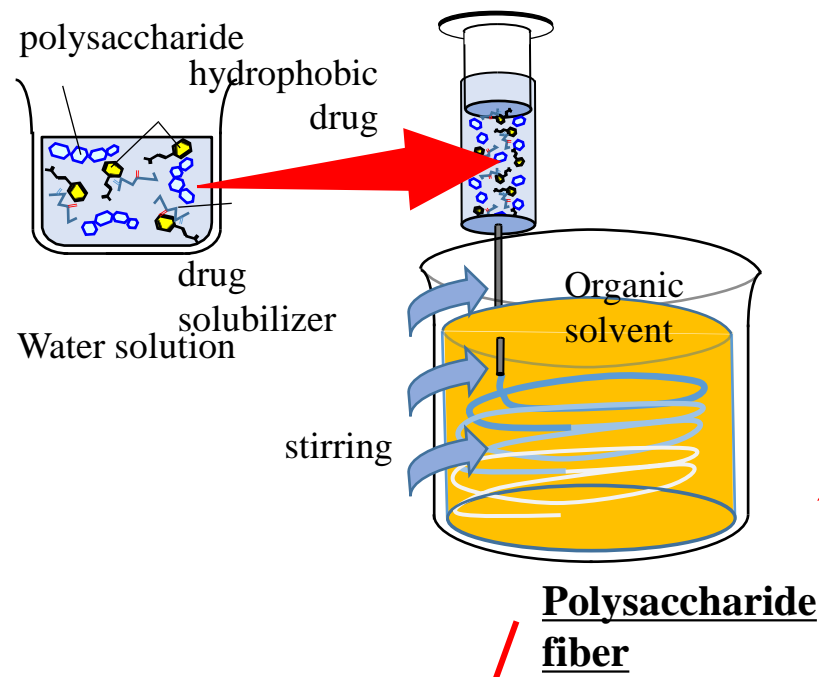
D - Research topic:

Coll. Pr. H. Imanaka

** Monitoring protein immobilization to design advanced biosensing devices

Functional biomolecule immobilization method:

- ➔ Engineered “tag” peptides with solid surface-affinity to control the orientation of biomolecules
- ➔ “Tag” helps to maintain their function and attach them to the surface of solid materials
- ➔ Elucidation of “tag”/biomolecules/surface interactions



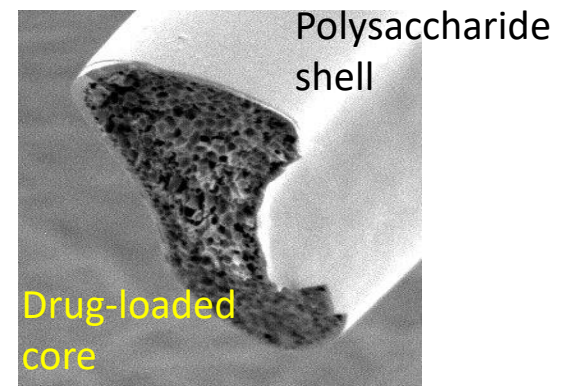
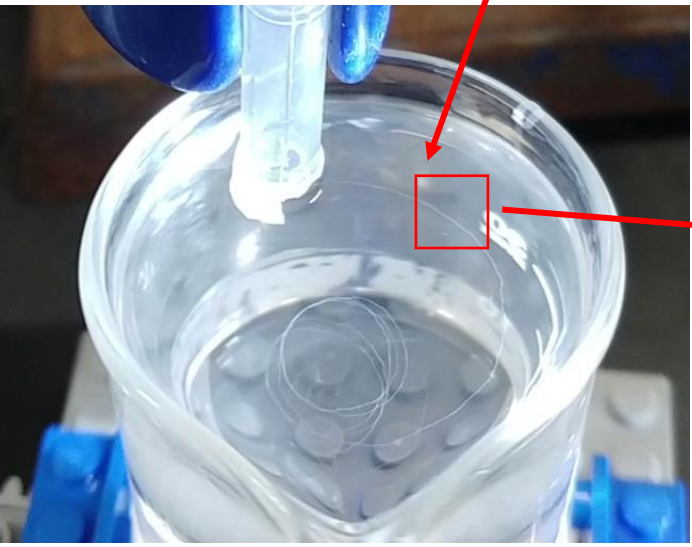
E – Research topic:

Coll. Dr. O. Tramis

**Design and production of innovative drug delivery systems (DDS)

Fiberization of drug-loaded polysaccharides:

- ➔ Low-cost device using eco-friendly production principle (i.e., precipitation of aqueous sugar solution into alcohol)
- ➔ Hydrophobic drug is loaded inside a “core-shell” structure
- ➔ Hydrophobic drug is sustainably released when fibre is dissolved in water



Drug-loaded fibre

Advanced low-cost production of DDS

Major Equipments

A – Microscopy

Inverted optical microscope Olympus CK2 (Sato Shouji Inc., Japan)
Atomic force microscope (Nanoscope IIIa; Veeco Instruments, USA)

B – Spectroscopy

UV-Vis V-730 spectrophotometer (Jasco Inc., Japan)
Fourier transform IR spectrometer (Nicolet 4700; Thermo Scientific Inc., Madison, WI)
*FTIR spectrometer (FT/IR 4600, JASCO Co.) with ATR (ATRPRO400-S, JASCO Co., Tokyo, Japan)

C – Protein synthesis

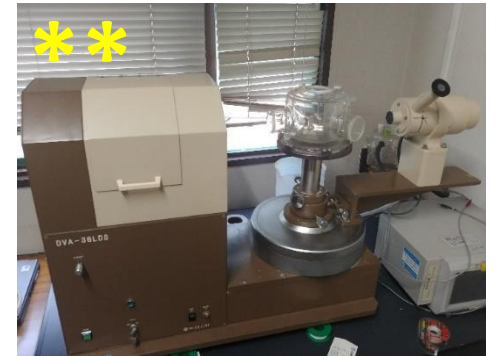
PCR GoTaqGreen Master Mix (Promega Co., Madison, WI)
Purifier Quantum Prep PlasmidMiniprep Kit (Bio-Rad Laboratories, Inc. (Hercules, CA)
Purifier High Pure Plasmid Isolation Kit (Roche)
DNA sequencer ABI PRISM 310 Genetic Analyzer (Milpitas, CA).

D – Physical chemistry

Modulated DSC Q2000 (TA Instruments Co., New Castle, DE)
Contact angle measurement Kruss EasyDrop (Kruss, Germany)
Zeta-potential analyser (ELSZ; Otsuka Electronics, Japan)

E – Other specific equipment

**Underwater ellipsometer (Mizojiri Optical Co. Ltd., Tokyo, Japan)
Ellipsometer (LTE; Gaertner Scientific, Germany)
Freeze-dryer (UT-80, EYELA TOKYO RIKAKIKAI Co., Tokyo, Japan)
Vacuum dryer (GLD-100, ULVAC Japan, Ltd., Tokyo, Japan)
Spray dryer (ADL-311-A, Yamato Scientific Co., Ltd., Tokyo, Japan)
***Advanced drug delivery production (homemade)



International

Collaborations

Group in France (Tarbes, INP-ENIT, Toulouse “III” university)

→ Protein Immobilisation on surfaces / solid dispersion of hydrophobic drugs

- Tramis, O., Iizuka, R., Nakao, H., Imanaka, H., Ishida, N., & Imamura, K. (2020). [Immobilization of surface non-affinitive protein onto a metal surface by an external electric field](#). *Journal of bioscience and bioengineering*, 129(3), 348-353.

- Sekitoh, T., Okamoto, T., Fujioka, A., Tramis, O., Takeda, K., Matsuura, T., ... & Imamura, K. (2020). [Sole-amorphous-sugar-based solid dispersion of curcumin and the influence of formulation composition and heat treatment on the dissolution of curcumin](#). *Drying Technology*, 1-10.

Group in Australia (RSPE, Australian National University) → AFM -- interaction forces between surfaces in air and liquid

- Ishida, N., & Craig, V. S. (2019). [Direct measurement of interaction forces between surfaces in liquids using atomic force microscopy](#). *KONA Powder and Particle Journal*, 36, 187-200.

- Ishida, N., Matsuo, K., Imamura, K., & Craig, V. S. (2018). [Hydrophobic attraction measured between asymmetric hydrophobic surfaces](#). *Langmuir*, 34(12), 3588-3596.

Young researchers supervision

Ms. Ei Ei Htwe, Myanmar, Ph.D. student 2013-2016 (3 years)

Dr. Tramis Olivier, France (Toulouse), Research Fellow, 2017-2018 (5 months) and 2019-2020 (6 months)

Dr. Daniel Jonathan, France (Bordeaux), Visiting researcher, 2018 (2 months)

Large Scale International Projects

MSCA – I-F ----- European-funded “Global” Fellowship –

Application submitted in September 2020 ---- collaborations with:

- ** Strasbourg University (France, Dr. Tramis), collaboration with IMS (Institut du Médicament de Strasbourg)
- ** Paris “Sud” University and
- ** Singapore “SUTD” University



Selected publications

Yokota, H., Kadowaki, M., Matsuura, T., Imanaka, H., Ishida, N., & Imamura, K. (2020). [The Use of a Combination of a Sugar and Surfactant to Stabilize an Au Nanoparticle Dispersion against Aggregation during Freeze-Drying](#). *Langmuir*, in press

Sekitoh, T., Okamoto, T., Fujioka, A., Tramis, O., Takeda, K., Matsuura, T., ... & Imamura, K. (2020). [Sole-amorphous-sugar-based solid dispersion of curcumin and the influence of formulation composition and heat treatment on the dissolution of curcumin](#). *Drying Technology*, in press

Takeda, K., Sekitoh, T., Fujioka, A., Yamamoto, K., Okamoto, T., Matsuura, T., ... & Imamura, K. (2019). [Physical Stability of an Amorphous Sugar Matrix Dried From Methanol as an Amorphous Solid Dispersion Carrier and the Influence of Heat Treatment](#). *Journal of pharmaceutical sciences*, 108(6), 2056-2062.

Htwe, E. E., Nakama, Y., Yamamoto, Y., Tanaka, H., Imanaka, H., Ishida, N., & Imamura, K. (2018). [Adsorption characteristics of various proteins on a metal surface in the presence of an external electric potential](#). *Colloids and Surfaces B: Biointerfaces*, 166, 262-268.

Shimizu, T., Korehisa, T., Imanaka, H., Ishida, N., & Imamura, K. (2017). [Characteristics of proteinaceous additives in stabilizing enzymes during freeze-thawing and-drying](#). *Bioscience, biotechnology, and biochemistry*, 81(4), 687-697.

Takeda, K., Gotoda, Y., Hirota, D., Hidaka, F., Sato, & Imamura, K. et al. (2017). [Surfactant-free solid dispersions of hydrophobic drugs in an amorphous sugar matrix dried from an organic solvent](#). *Molecular Pharmaceutics*, 14(3), 791–798.

Imanaka, H., Yamadzumi, D., Yanagita, K., Ishida, N., Nakanishi, K., & Imamura, K. (2016). [The use of a proteinaceous “cushion” with a polystyrene-binding peptide tag to control the orientation and function of a target peptide adsorbed to a hydrophilic polystyrene surface](#). *Biotechnology progress*, 32(2), 527-534.

BPE lab members FY 2019

