

Research topics for graduate students enrolled in 2024

Professor Ryo Shirakashi

Department of Mechanical Engineering (Institute of Industrial Science)

Acceptable course(s)

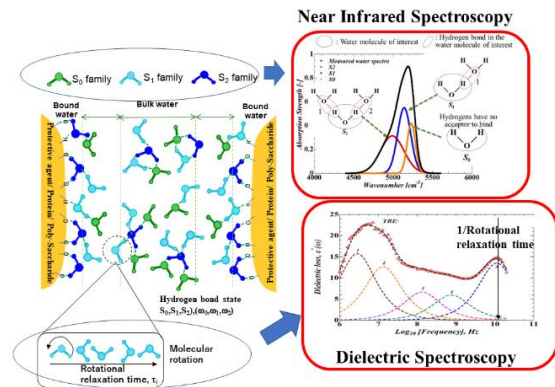
- Master's Degree
- Doctoral Degree



Research Topics

Molecular and micro/nano scale kinetics and thermophysical properties dominating the various functions of biomaterials;

The near-infrared(NIR) and the dielectric spectroscopic analysis with MD are used to open a new aspect of water-rich materials including living cells, biomaterials and hydrophilic porous materials in the fields of biomedical, foods and energy engineering. See below for recent topics.



1. Stabilization of clinical analytes and pharmaceuticals for their long-term high-quality preservation

Thin film rapid drying method[1] enables a room temperature drying of biomarker proteins. The potential applications of this method include the dry-preservation of liquid analytes for biobank, liposomal drug and test-kits using proteins.

2. High spatial resolution measurement of water rotational relaxation time in materials

We have recently developed the original method for measuring the rotational relaxation time of water in microscale resolution using NIR micro spectroscopy[2]. This property could predict some macroscopic features of materials such as the deterioration rate of protein[3] and the local water diffusion coefficient in biomaterials[4].

3. Design and screening of the protective agents of biomaterials

Molecular dynamics(MD) simulation supported by dielectric spectroscopy reveals the mechanism how water dynamics changes by addition of biomolecules[5],[6], which gives a guideline of screening and even designing optimum bioprotective agent molecules.

Articles Related to Research Topics

- [1] L. Wei and R. Shirakashi, *J. Food Process Eng*, DOI: 10.1111/jfpe.13962 (2022)
- [2] J. Zhang, H. Matsuura and R. Shirakashi, *J. Food Process Eng*, **e14095**, DOI: 10.1111/jfpe.14095 (2022)
- [3] L. Wei and R. Shirakashi, *J. Phys. Chem.B*, **124**, 8741-8749 (2020)
- [4] J. Zhang H. Matsuura and R. Shirakashi, *J. Food Process Eng*, **e14335**, DOI: 10.1111/jfpe.14335 (2023)
- [5] K. Hu H. Matsuura and R. Shirakashi, *J. Phys. Chem.B*, **126**, 24, 4520–4530, DOI: 10.1021/acs.jpcc.2c00970 (2022)
- [6] K. Hu and R. Shirakashi, *J. Mol. Liqs.*, **380**,121707, DOI: 10.1016/j.molliq.2023.121707 (2023)

Lab. Web page: <https://www.iis.u-tokyo.ac.jp/~aa21150/indexe.html>