

Research topics for graduate students 2024

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Acceptable course(s)

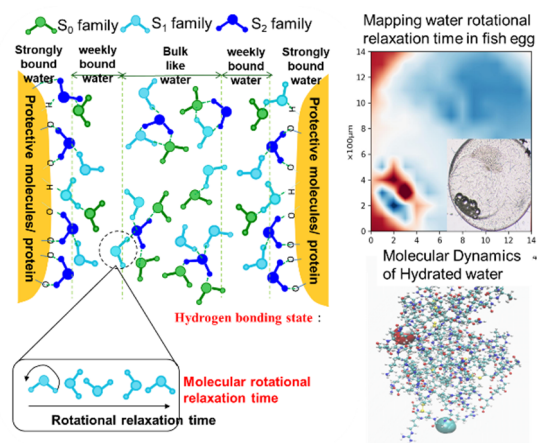
- Master's Degree
- Doctoral Degree



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. Fabrication and preservation of functional scaffold for tissue engineering

Scaffolds are essential materials in tissue engineering. They should have microvascular networks inside to supply sufficient oxygen and nutrient to support attached cells in extremely high density. Fabrication and preservation of such structure with chemical modified surface is the challenging topic in reproduction medicine.

2. High spatial resolution measurement of water rotational relaxation time in developing fertilized egg

We have recently developed the original method for measuring the rotational relaxation time of water in microscale resolution using NIR micro spectroscopy[1]. This property could predict local diffusion coefficients in biomaterials, molecular viscosity of water [2] in intact cells [3].

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[4],[5], which gives a guideline of screening and even designing optimum bioprotective agent molecules.

Articles Related to Research Topics

- [1] J. Zhang, H. Matsuura and R. Shirakashi, *J. Food Process Eng*, **e14095**, DOI: 10.1111/jfpe.14095 (2022)
- [2] J. Zhang H. Matsuura and R. Shirakashi, *J. Food Process Eng*, **e14335**, DOI: 10.1111/jfpe.14335 (2023)
- [3] J. Zhang and R. Shirakashi, *BBRC*, 149857, DOI: 10.1016/j.bbrc.2024.149857 (2024)
- [4] K. Hu and R. Shirakashi, *J. Mol. Liqs.*, **380**,121707, DOI: 10.1016/j.molliq.2023.121707 (2023)
- [5] K. Hu and R. Shirakashi, *CPL*, 141302, DOI: 10.1016/j.cplett.2024.141302 (2024)

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