

Water Frontier Science & Technology Research Center

Period : from Nov. 22 / 2016 to Mar. 31 / 2021

Members (Department, FACULTY)

(Director)	Chemistry, SCI.	Hiroharu YUI	(Vice director)	Phys., SCI.	Yoshikazu HOMMA
(Group Leader)	Mech. Eng., ENG.	Shinya SASAKI	(Group Leader)	Appl. Chem., SCI.	Hidenori OTSUKA
(Group Leader)	Mech. Eng., SCI. & ENG.	Ichiro UENO	(Group Leader)	Liberal Arts, ENG.	Takahiro YAMAMOTO
(Group Leader)	Mech. Eng., ENG.	Masahiro MOTOSUKE	(Group Leader)	Appl. Chem., SCI.	Izumi NAKAI
(Member)	Pure & Appl. Chem., SCI. & ENG.	Hideki SAKAI	(Member)	Mech. Eng., SCI. & ENG.	Takahiro TSUKAHARA
	Mat. Sci. & Tach., IND. SCI. & ENG.	Masato KOTSUGI		Appl. Phys., SCI.	Tetsuaki ITO
	Phys., SCI.	Kazuhiko MIURA		Phys., SCI.	Eiji TOKUNAGA
	Chem., SCI.	Koichi TSUKIYAMA		Chem., SCI.	Makoto TADOKORO
	Ind. Chem., ENG.	Takeshi KAWAI		Ind. Chem., ENG.	Mineo HASHIZUME
	Appl. Phys., SCI.	Yutaka SUMINO		Appl. Elec., IND. SCI. & ENG.	Tadashi ANDO
	Photocatalysis International Research Center, RIST			Chiaki TERASHIMA	
(Visiting Researcher)	Univ. Tokyo	Hirohumi DAIGUJI		Electro Communications Univ.	Takayoshi KOBAYASHI
	Osaka City Univ.	Tatsuru SHIRAFUJI		Tohoku Univ.	Hiroshi MATSUI
	Osaka Univ.	Yasutaka YAMAGUCHI		Mizuho Info. & Res. Inst. Inc.	Naotaka WATANABE
	Mizuho Info. & Res. Inst. Inc.	Koichiro KATO			

➤ Objectives

Contribution to both the deepening of basic researches and the development of the controlling technologies of water structures and dynamics (wetting and flow) at the surfaces of various materials that can be utilized in promoting energy saving through low-frictional machinery, regenerative medicine, and developing new devices and green technologies.

➤ Research topics

We study water on materials' surfaces through the following 6 concepts by corresponding group (G)s .

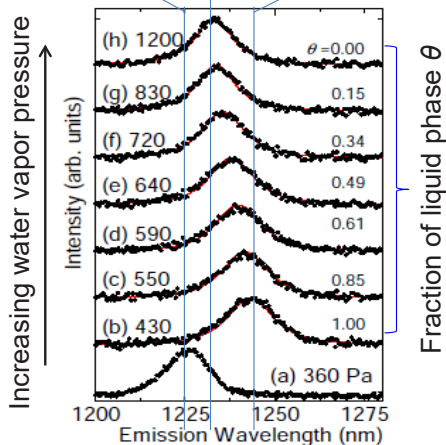
- 【G1】 Water on materials' surfaces: statistical thermodynamics and energy saving technologies
- 【G2】 Bio-interface: hydration structures of biocompatible hydropolymers for regenerative medicine
- 【G3】 Wetting and flow dynamics: basic researches and applications to material & energy technologies
- 【G4】 Theories and simulations: basic researches for multiscale structure and dynamics of water
- 【G5】 Measurements and controls on flow dynamics: for the development of novel fluidic devices
- 【G6】 Chemical reactions and analyses: advanced applications of water for green chemistry

➤ Activities past, present and future

- Established in Nov. 2016 by the aid of the research promotion program by the MEXT Japan
- Advisory committee held in March 21 / 2017
- Kickoff meeting held in March 27 / 2017
(Total: over 100 participants (80 participants from companies and other research institutes))
- Industry & Academia Joint research meetings held in April 24 , July 6, and Sept. 13 / 2017
- An educational lecture course for the general public in Nov. 4 / 2017 (Scheduled)
- Meeting to report results in Nov. 25 / 2017 (Scheduled)
- Education cause for graduate students with tutorials by all the members (Sep. 2017 ~ Jan. 2018)
- Intra & inter groups' meetings for starting synergetic researches (already held many times)
- Promotion of collaborative researches in intra- & inter-groups, divisions-center, and industries-academia

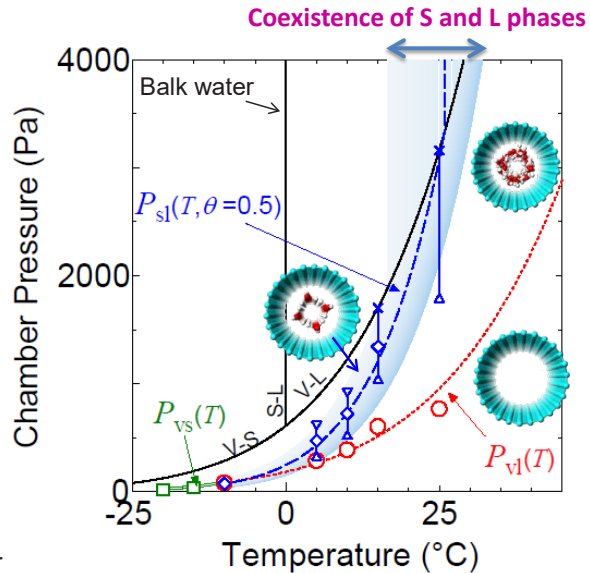
Topic ① Clarification of the Phase diagram of Water Confined in Carbon Nanotube (CNT)

Measurement of water phase in CNT (1nm-diam.)



Water vapor pressure dependence of photoluminescence spectrum from CNT

- ✓ Elucidation of peculiar phase diagram of 1D water
- ✓ Extinction of S-L phase transition
- **Thermodynamics in 1D**



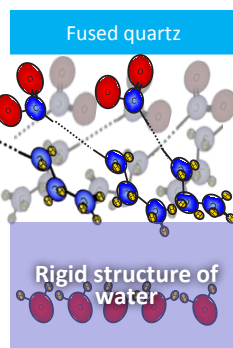
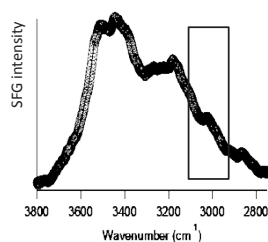
Collaborative research with the members in our center (Dr. Homma, Dr. Yamamoto, Dr. Ito and Dr. Yui) and with the members in Division of Nanonarbon Research (Dr. Konabe and Dr. Chiashi) by the synergetic approach and by the aid of Grants-in-Aid for Scientific Research (A) (2016-2018).

Topic ② Selective in-situ observation of the changes in hydrogen-bonding network of water on the sliding surface

Application of vibrational sum frequency generation (SFG) spectroscopy

Static condition

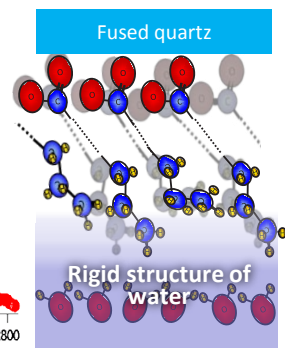
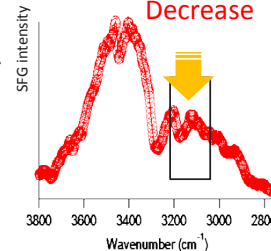
Peaks of Rigid structure of water



Under lubrication

Sliding

Peaks of Rigid structure of water



Interfacial system: water with surfactants (stearic acid)

The results will be applicable to deepening the science of interfacial water in tribology and to accelerate the development of the low-frictional surfaces with water molecules.

Cooperative research with the members in our center (Dr. Sasaki, Dr. Homma, Dr. Yamamoto, Dr. Sakai, and Dr. Yui) by the synergetic approach with combining measurements and simulations approaches. Application of the heterodyne SFG spectroscopy and AFM instruments are now also under planning.