

## Research topics for graduate students for 2025

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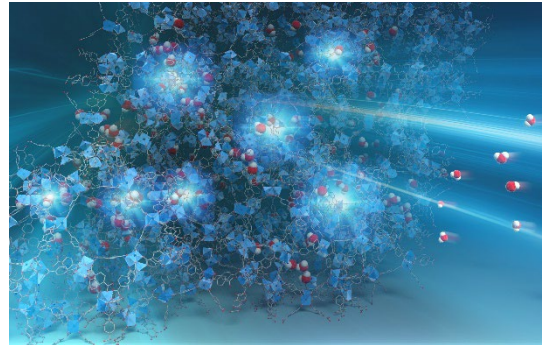
Acceptable course(s)

- Master's Degree
- Doctoral Degree



#### Research Topics

To further evolve conventional energy technology or popularize new energy technologies, it is necessary to further develop energy-saving technology. We are aiming to advance diverse energy technologies for energy-saving systems by scrutinizing physical phenomena such as phase changes and micro/nanoscale heat and mass transfer.



#### 1. Research for next generation HVAC (Heating, Ventilation, and Air Conditioning) technology

Due to a galloping rise in the energy demand by the buildings in the recent decades, the transition from a conventional building to a sustainable net zero energy building has been realized globally. The new HVAC technology will be challenged [1].

#### 2. Experiment and simulation study of gas adsorption in mesoporous materials

Mesoporous metal-organic frameworks (MOFs) are potential materials for efficient water and CO<sub>2</sub> adsorption and desorption processes in gas separation and purification and heat-pump systems. Pore filling/pore emptying processes of various mesoporous MOFs have been studied experimentally and by simulation [2].

#### 3. Analysis and control of boiling in nanopores

Historically, bubble dynamics has been studied from a scientific standpoint, while boiling phenomena have been studied from an engineering standpoint, and there seems to have been little contact between the two. Here, we challenge to understand boiling phenomena inside nanopores from the dynamics of single vapor bubbles [3].

#### Articles Related to Research Topics

- [1] Jubair Ahmed Shamim, Gunjan Auti, Hibiki Kimura, Shubo Fei, Wei-Lun Hsu, Hirofumi Daiguji and Arun Majumdar, "Concept of a hybrid compression-adsorption heat pump cycle," *Cell Reports Physical Science* **3**, 101131 (2022). [DOI: [10.1016/j.xcrp.2022.101131](https://doi.org/10.1016/j.xcrp.2022.101131)]
- [2] S. Fei, J. Gao, R. Matsuda, A. Endo, W.-L. Hsu, J.-J. Delaunay and H. Daiguji, "Temperature effect on water adsorption and desorption processes in the mesoporous metal-organic framework MIL-101(Cr)," *Journal of Physical Chemistry C* **126**, 15538–15546 (2022). [DOI: [10.1021/acs.jpcc.2c05603](https://doi.org/10.1021/acs.jpcc.2c05603)]
- [3] S. Paul, Y. Ito, W.-L. Hsu and H. Daiguji, "Thermodynamic bifurcations of boiling in solid-state nanopores" *Physical Review Research* **6**, 013110 (2024). [DOI: [10.1103/PhysRevResearch.6.013110](https://doi.org/10.1103/PhysRevResearch.6.013110)]

Lab. Web page: <http://www.thml.t.u-tokyo.ac.jp/index.html>