

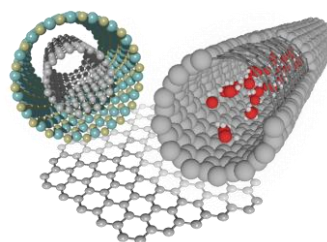
Research topics for graduate students for 2023

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Department of Mechanical Engineering

Acceptable course(s)

- Master's Degree
- Doctoral Degree



Research Topics

The main research topics are the synthesis, characterization, and application of nanomaterials. In our group, through nanomaterials research, we also aim to discover the novel nanoscale physical, chemical, and transport phenomena, and to develop nanotechnology. Below are some research themes.

1. Synthesis and characterization of nano-materials

We have been researching the synthesis of nanocarbon materials such as single-walled carbon nanotubes and graphene, as well as hexagonal boron nitride, other two-dimensional atomic layered materials, and heteronanotubes [1]. Based on the synthesis techniques, we aim to develop the construction technology of nanoscale structures. In the analysis of nanomaterials, non-contact and non-destructive optical property measurement is one of the very important analytical techniques. Along with the development of spectroscopic measurement methods and measurement systems, we are also working on clarifying the interesting optical properties of nanomaterials.

2. Elucidation of new phenomena in the nanoscale

In addition to research on nanomaterials themselves, we aim to discover novel physical and chemical phenomena associated with nanomaterials and to develop their applications. For example, water encapsulated in the inner space of a nanotube with a diameter of 1 nm has strange thermodynamic properties [2]. We aim to elucidate thermodynamics in the nanoscale (nano-thermodynamics) and find new applications.

3. Applications of nanomaterials

Single-walled carbon nanotubes are excellent electrically conductive materials, but there are many problems in their practical application. We are working on the development of methods for fabricating flexible single-walled carbon nanotube thin films and yarns with high electrical conductivity, as well as the evaluation of their characteristics.

Articles Related to Research Topics

[1] R. Xiang, et al., "One-dimensional van der Waals heterostructures," *Science*, **367** (2020) 537. DOI: 10.1126/science.aaz2570

[2] S. Chiashi, et al., "Confinement Effect of Sub-Nanometer Difference on Melting Point of Ice-Nanotubes Measured by Photoluminescence Spectroscopy," *ACS Nano*, **13** (2019) 1177. DOI: 10.1021/acsnano.8b06041

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