Research topics for graduate students for 2023

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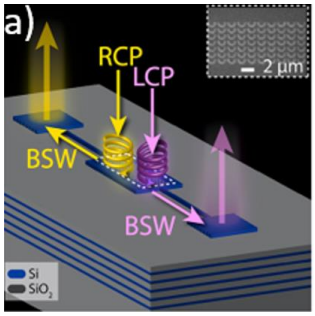
Department of Mechanical Engineering

Acceptable course(s)

- Master's Degree
- Doctoral Degree

Research Topics

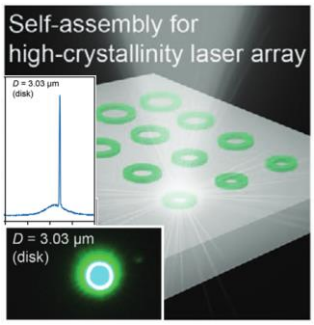
The laboratory specializes in the development of functional materials for use in sensing and energy conversion. Particularly, electromagnetic, optical, and acoustic metamaterials are investigated to address technological issues such as electrical power consumption reduction utilizing optical circuits, efficient production of chemical energy sources from solar radiation, and sound mitigation. The current research topics are related to chirality sensing, spectrally selective coatings, and photocatalytic materials.



1. Chirality sensing [1]

Circularly polarized waves can have two states or spins, namely, left and right circular polarization. We have developed a filter to separate left from right circularly polarized waves and are developing novel chirality sensing schemes for use in biomolecule characterization in the pharmaceutical field. On the same optical platform, we have also demonstrated optical logic gates that can be applied to optical data communication.

2. Coherent microlasers [2]



Microfabricated lasers on a chip have been realized using top-down fabrication techniques. These small and micro-integrated coherent light sources are an essential part for the development of optical sensing and communication systems.

3. Metamaterials for sound mitigation

Structured materials (meta-materials) that can be fabricated by additive manufacturing are being developed for use in the sound attenuation of exhaust ducts.

Articles Related to Research Topics

[1] CZ Deng et al., "Near-Zero-Index Slabs on Bloch Surface Wave Platform for Long-Range Directional Couplers and Optical Logic Gates," ACS Nano 16 (2), 2224-2232, 2022; Light Switching with a Metal-Free Chiral-Sensitive Metasurface at Telecommunication Wavelengths, ACS Photonics 7, 2915, 2020.

[2] D. Xing et al., "Self-Healing Lithographic Patterning of Perovskite Nanocrystals for Large-Area Single-Mode Laser Array," Advanced Functional Materials, 31, 2006283, 2021.

[3] Z. Wang et al., "Ultra-narrow and wavelength-tunable thermal emission in a hybrid metal-optical Tamm state structure," ACS Photonics, 7, 6, 1569–1576, 2020.

Lab. Web page: http://scale.t.u-tokyo.ac.jp/