Nanoscience Center for Photonics, Electronics, and Materials Engineering (NPEM)

NPEM

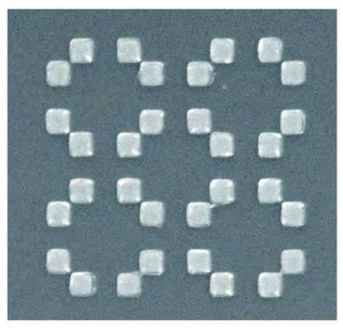
https://npem.iis.u-tokyo.ac.jp/

Technologies for fabricating, observing, and measuring nanoscale systems have been making a rapid progress in recent years. Understanding of material properties from their nanoscale physics/chemistry is essential for future scientific and technological breakthroughs. In nanoscale regions, physics, chemistry, and materials science are no longer independent disciplines; instead, interaction of these fields is becoming indispensable for creating new research directions. The objective of this center is to pursue such interdisciplinary research through collaboration of the member research groups and create a new paradigm in science and engineering.

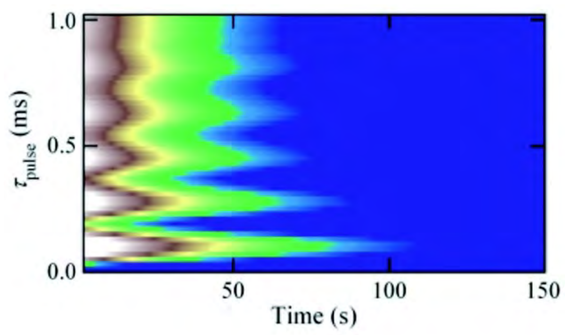
Nano-photophysics

Prof. Tsutomu Shimura
Prof. Tomoki Machida

Substances having a structure smaller than the wavelength of light, and monolayer materials such as graphene exhibit unique optical and electrical properties. By creating new nanostructures and monoatomic layer materials, we will develop novel phenomena and clarify their physics. We also aim to create new devices for photonics, electronics, and spintronic using these phenomena.



50 nm square gold nano-structure
Optical field is enhanced by the plasmon at the gap region.

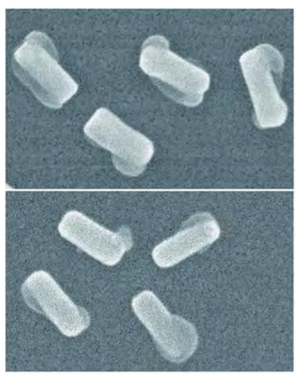


Rabi oscillation of quantum state

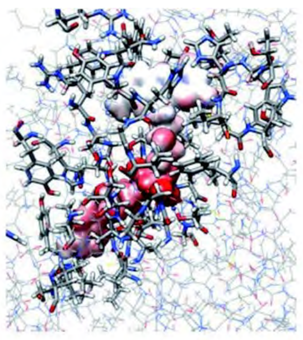
Nanophotonic Materials

Prof. TetsuTatsuma
Prof. Fumitoshi Sato
Prof. Kazuyuki Ishii

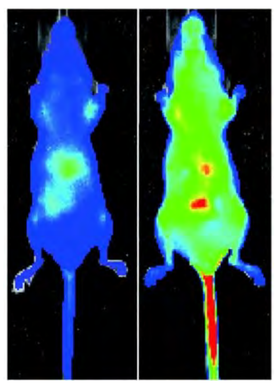
We pursue photonic and electronic functionalities of metal and semiconductor nanomaterials, organic molecules, and biomolecules. We also develop their hybrids, for applications to energy conversion, molecular computing, and high-density data storage, in collaboration with other groups in the center.



Chiral plasmonic nanoparticles



Electrostatic potential on the FAD in glucose oxidase

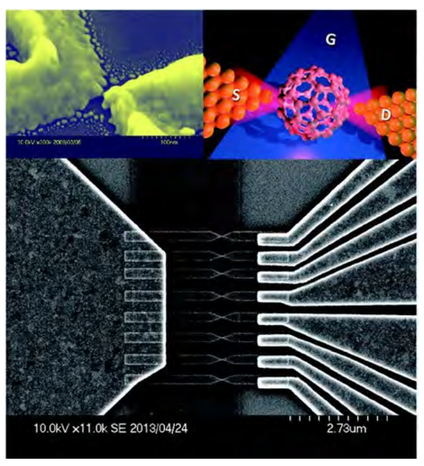


Fluorescent imaging of Vitamin C in a mouse

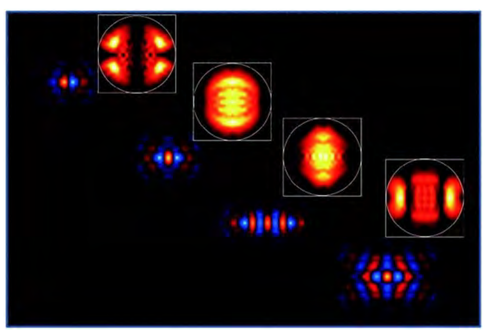
Nanoelectronics

Prof. Kazuhiko Hirakawa
Prof. Satoshi Iwamoto

We will explore a new paradigm for electronics and photonics by controlling electrons, photons, and phonons in nano/microstructures. To this end, we will establish fabrication technologies of ultrasmall electronic/photonic structures. Furthermore, electronic properties and light-matter interactions in such nano/microstructures will be investigated to realize novel information processing and photonic technologies, highsensitivity sensing, and novel electron-photon control schemes.



Ultrasmall single molecule transistor
- contacting a single molecule by metal nanogap electrodes

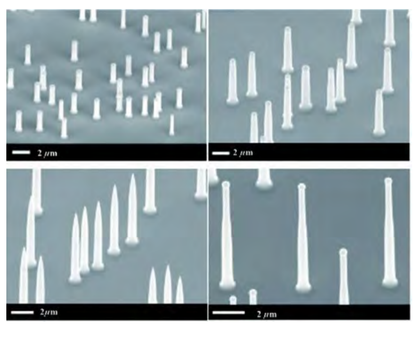


Control of light-matter interactions using photonic crystal nanocavities

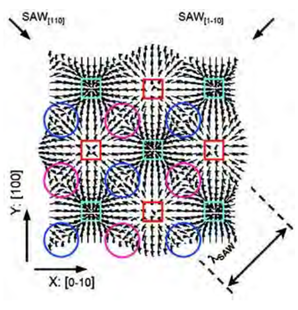
Nanomaterials and Nanodevices

Visiting Prof.
Tetsuomi Sogawa

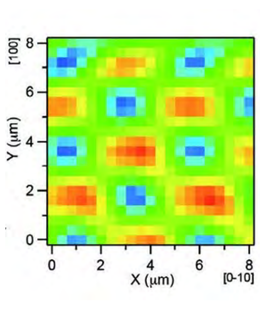
The VLS method enables us to produce high quality semiconductor nanowires and precisely control their structures. We also try to produce novel dynamic nanostructures, whose positions and dimensions are electrically tuned, by applying surface acoustic waves to quantum well structures. Our research on spin and optical properties of these nanostructures is expected to lead to functional quantum devices.



InP nanowires for different TMIn flow rate profiles



In-plane strain distribution by SAW



Spatial modulation of photoluminescence intensity