

Name	Prof. Yoshiaki NAKANO	Location	RCAST	Research Field	Optoelectronic Device
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## Research on Semiconductor Lasers, Light-Controlling Devices and Monolithically-Integrated Photonic Circuits

**Research Subject:** We are investigating new and high performance semiconductor lasers and semiconductor light controlling devices (such as optical switches, wavelength converters, and optical amplifiers) as well as highly-functional semiconductor integrated devices and photonic circuits fabricated by integrating the optical devices above. Crystal growth technologies and micro fabrication process technologies of compound semiconductors (in particular, the long-wavelength quantum micro-heterostructures by InGaAsP and InGaAlAs on InP) are also being studied.

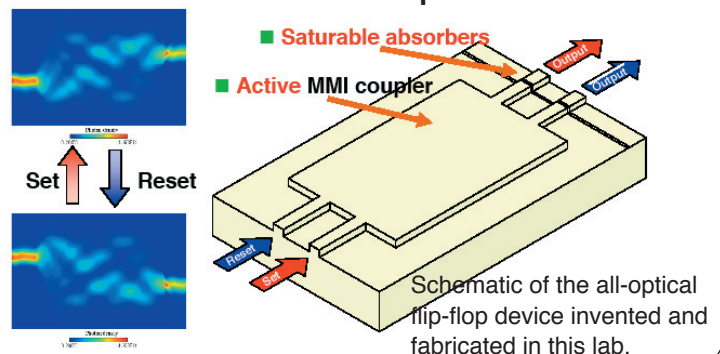
**Features:** This laboratory is unique in the sense that they fabricate semiconductor photonic devices and integrated circuits by themselves from scratch. Although it doesn't make sense to compete with companies in terms of reliability and scale of integration, the real devices exhibit significant difference from the "virtual devices" modeled on computers. Overlooked problems, unexpected results, and mysterious phenomena always pop up while we talk to the fabricated real devices. These provide us with new research ideas and seeds of inventing novel revolutionary devices. Dialogue with real devices is an essential process for this laboratory's research.

**Organization:** The lab. is operated together with Associate Professor Masakazu Sugiyama. In 2006 academic year, there are 13 postdoc/visiting researchers, 9 doctoral and 7 master graduate students, and 5 undergraduates besides 6 faculty and staff members (1 professor, 1 assos. professor, 2 assistant professors, 2 administrative assistants).

### Form of Research

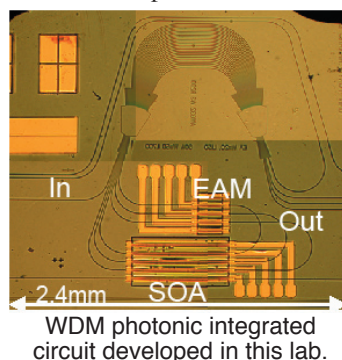
- ☐ Understanding fundamentals
- ☐ Modeling of devices
- ☐ Simulation of characteristics
- ☐ Computer-aided design of devices
- ☐ Development of fabrication process
- ☐ Fabrication of devices
- ☐ Measurement of static, dynamic, and noise characteristics

### Device Example

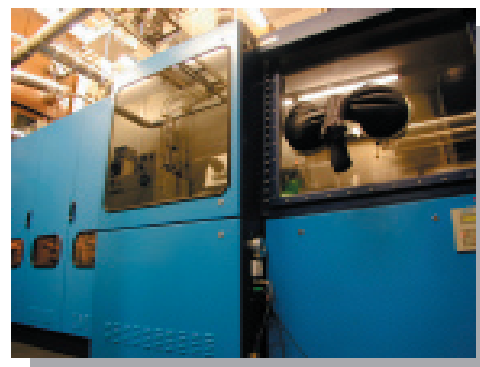


### Ongoing Research Topics

- ☐ GaN/AlN quantum well ISBT ultra-fast optical switch
- ☐ Semiconductor optical isolator
- ☐ InAsP QW DFB laser
- ☐ All-optical flip-flop
- ☐ All-optical device based on EA modulator
- ☐ All-optical switch circuit based on semiconductor optical amplifier
- ☐ Semiconductor arrayed waveguide grating photonic circuit.....and much more



### MOVPE Reactor



### Research Tools

- ☐ Fundamentals: Electromagnetism, wave optics, and quantum optics for photon system, quantum statistical mechanics for electron system., etc.
- ☐ Analysis/design: Several different CADs on PCs and workstations.
- ☐ Fabrication: Metal-organic vapor phase epitaxy (MOVPE) + spectroscopic ellipsometer, molecular beam epitaxy (MBE), ultrafine electron beam lithography for photonic integrated circuits, induction-coupled-plasma reactive ion etching (ICP RIE), laser micromachining, photolithography facilities, clean rooms, etc.
- ☐ Characterization: Electron microscope, 4 crystal X-ray diffractometer, micro photoluminescence, tunable lasers, 50GHz oscilloscope, 40GHz network analyzer, optical signal analyzer, optical spectrum analyzer, streak camera, etc.



Forward any question or request for lab visit to Y. Nakano (nakano@ee.t.u-tokyo.ac.jp, <http://www.ee.t.u-tokyo.ac.jp/~nakano/lab/welcome.html>)