Conveying the Joy of Doing Science

NICT Digital Media Series

Toward the World's Cutting Edge of Research

Record: Inter Opt 2005

Date: Wednesday, July 13 – Friday, July 15, 2005

Place: Makuhari Messe (International Exhibition Hall)

NiCT
Basic and Advanced Research Department
National Institute of Information and Communications Technology

Photonic Information Technology Group
Research Activities

Photonic Information Technology Group

Basic and Advanced Research Department
National Institute of Information and Communications

Quest for the leading edge of photonic technology and challenge for the discovery of new concepts & the development of seeds technologies

Millimeter-wave Photonics

Integrated Photonics

VICT
Versatile photonic ICT

Optical Frequency Standards

Collaboration with universities and corporations in Japan and abroad

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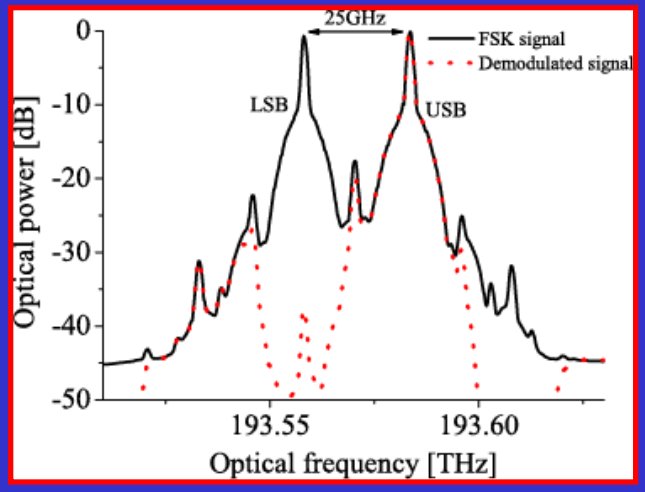
Optical Modulation & Control Device 1

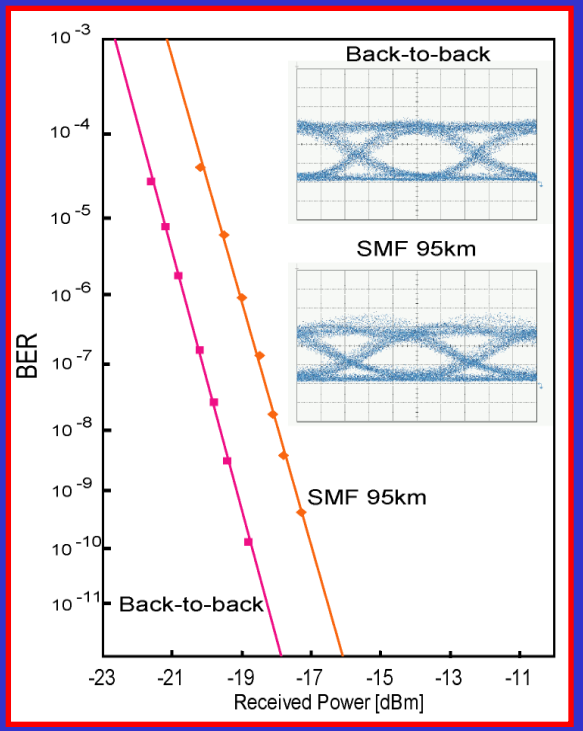
Development of the world's first optical FSK modulator (February 2004)

- High-speed precision control of the three optical elements (amplitude, phase, frequency)
- Announcement of optical phase continuous FSK modulation method (September 2004) and demonstration experiment at 10 Gbps (March 2005)
- Completion of technology transfer to Sumitomo Osaka Cement Co., Ltd. (10 Gbps FSK modulator)

Output light spectrum

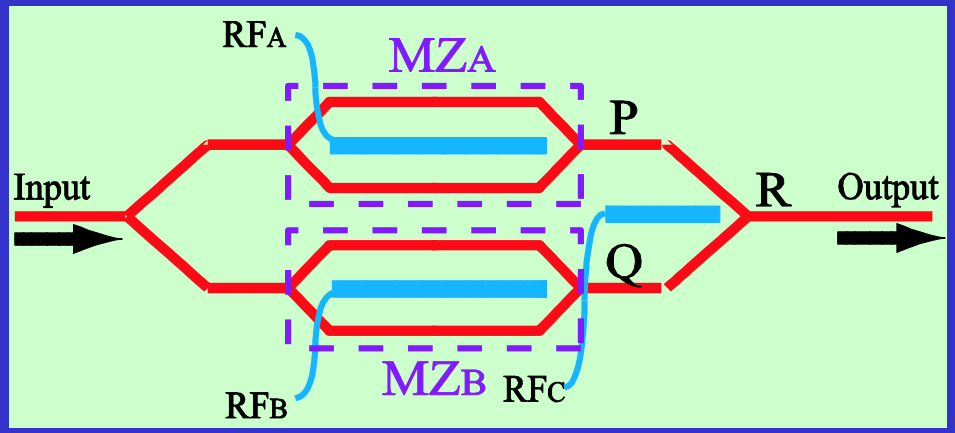


Transmission characteristics



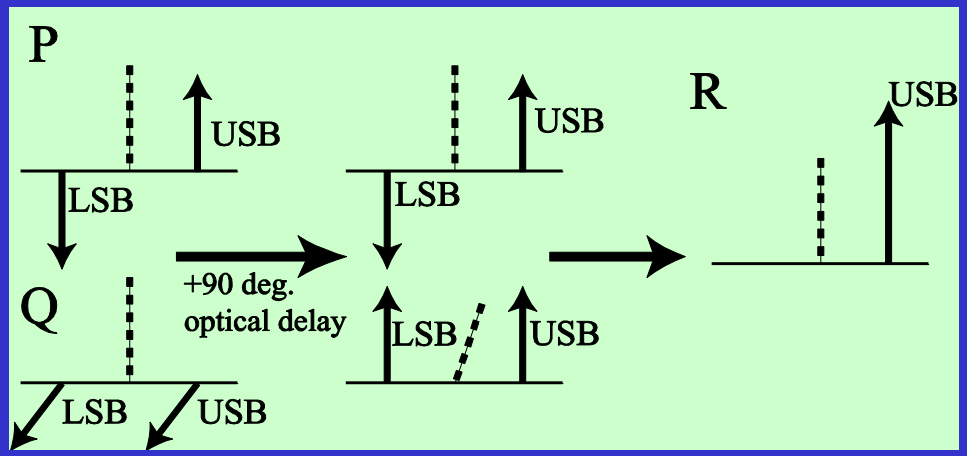
Optical Modulation & Control Device 2

Device structure



RFA, RFB: High-frequency signal
⇒ Generation of side band
RFC: Base band signal f(t)
⇒ Selection of side band (USB or LSB)
Removal of unwanted components through interference effect

Principle of operation



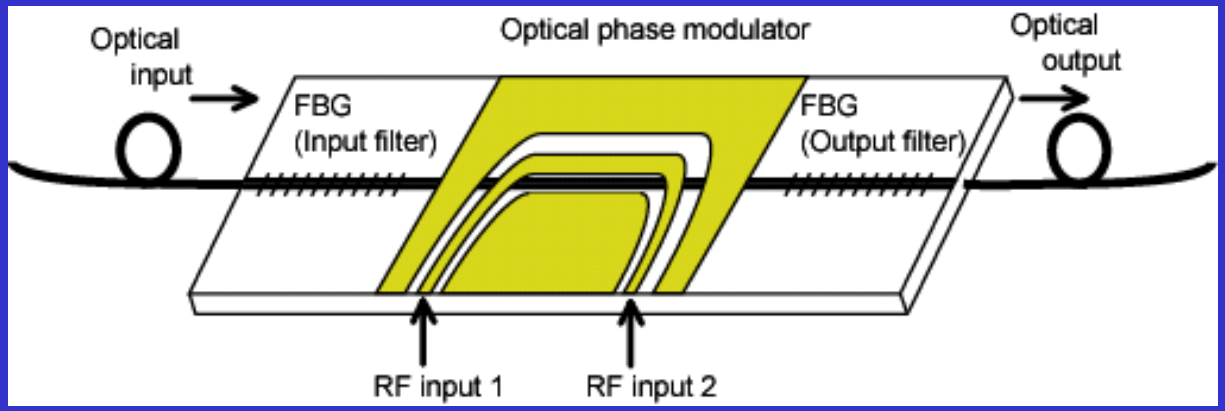
Features:
1) Stable and high speed
2) Potential for increasing the speed
3) Applicable to the optical frequency sweeper
4) Phase continuous modulation (CPFSK)
⇒ High-density transmission

Optical Wave-Microwave Fusion & Generation of Ultrahigh-speed Signal

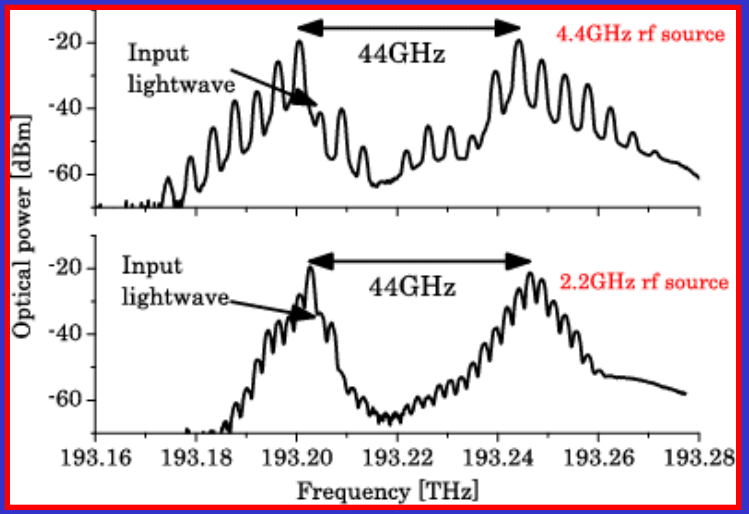
Modulation of millimeter-wave to generate ultrahigh-speed signal using a reciprocating multiplication modulator

- Applicable to fiber radio transmission systems and high-speed clock signal generators
- Generates high frequency components from low frequency electrical signal. (Ex. From 2 GHz to 60 GHz)
- Automatic oscillation of stable and low-noise millimeter-waves through use with a photoelectric oscillator. Potential for generating even higher frequency waves.

Reciprocating multiplication modulator



Output light spectrum



Generates stable millimeter-wave signal from microwave.

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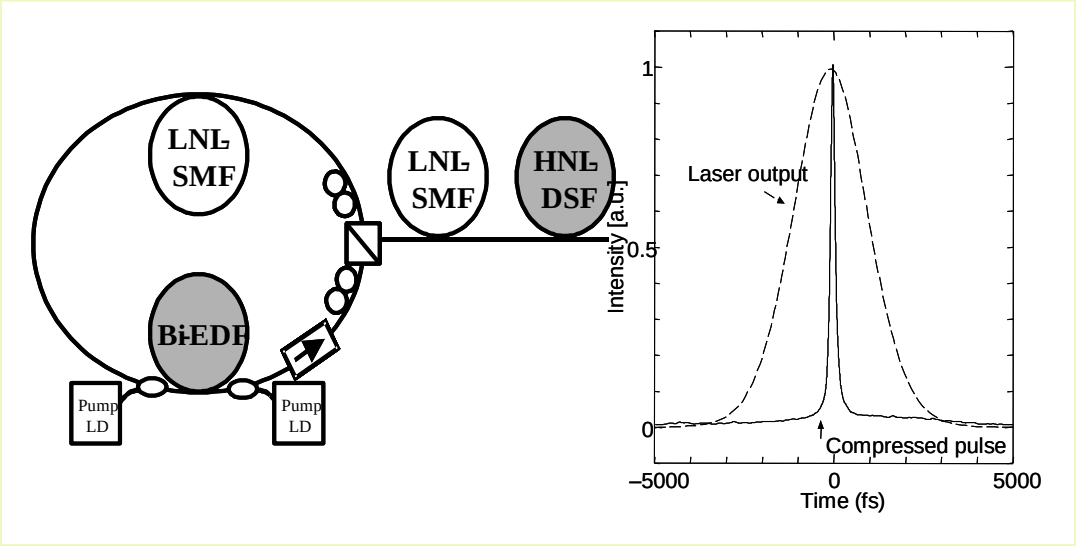
Ultrahigh-speed, Ultrawideband Light Source & Its Application 1

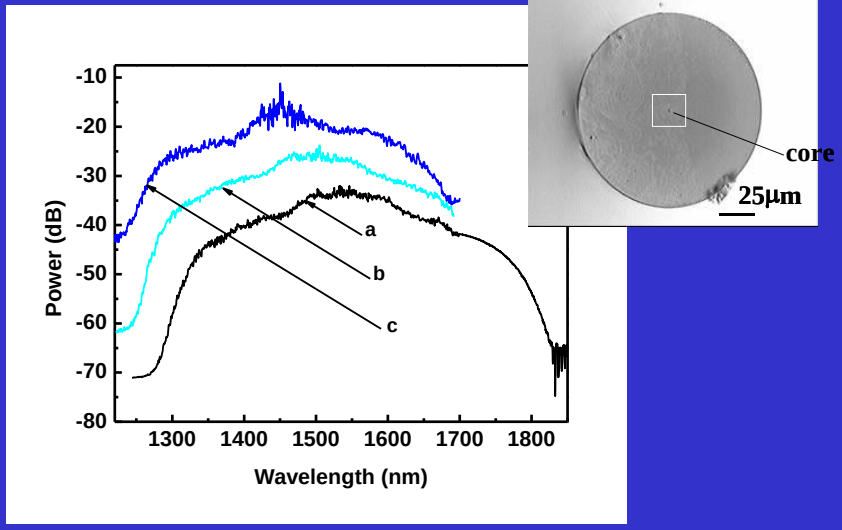
Small, highly stable femtosecond laser ultrawideband light source

- Development of ultrawideband, ultrahigh-speed laser
- Application and measurement of the femtosecond range ultrahigh speed phenomenon
- Application to engineering such as laser processing and ultraprecision distance measurement is possible.

Small, highly stable femtosecond laser



Ultrawideband photoproduction using ultrahighly nonlinear fiber

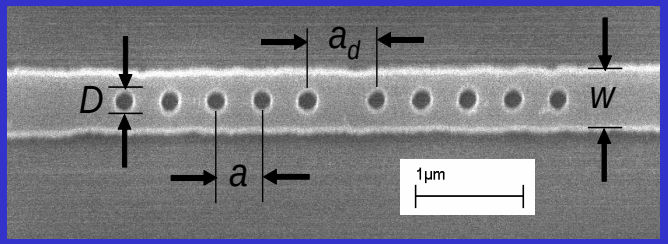


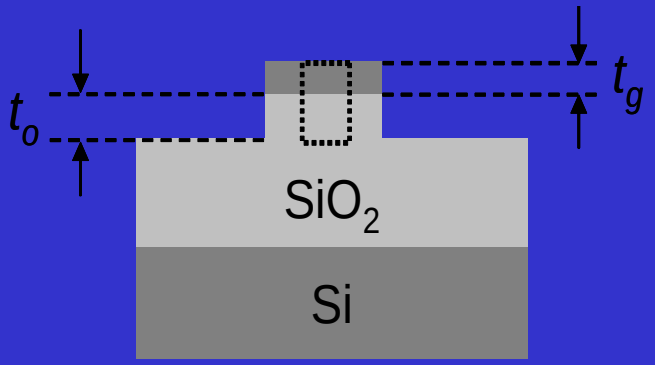
Ultrahigh-speed, Ultrawideband Light Source & Its Application 2

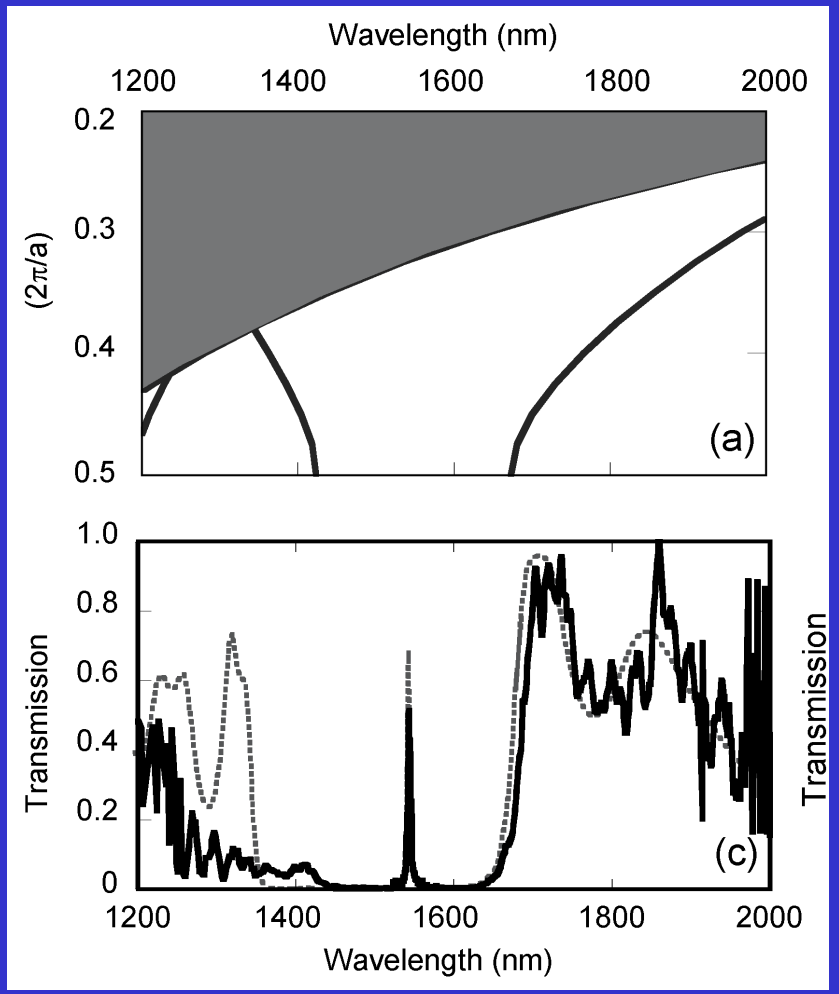
Evaluation of optical characteristics of photonic device using ultrawideband light

- Easy, quick evaluation of ultrawideband optical characteristics
- Evaluation of ultrawideband optical characteristics of 1-3 dimension photonic crystallization

Example of photonic crystallization device





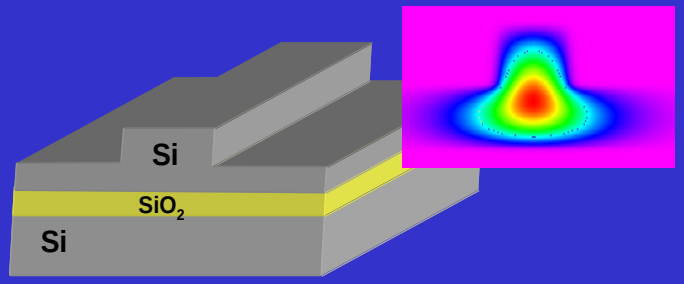


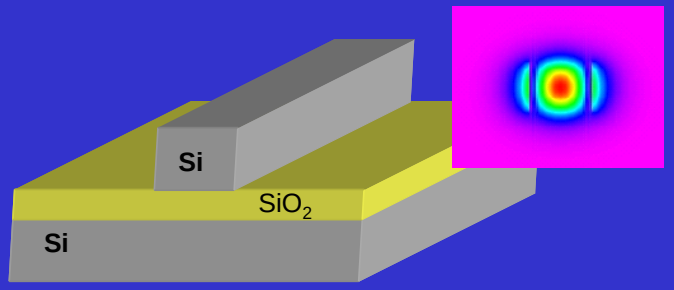
Silicon Photonics

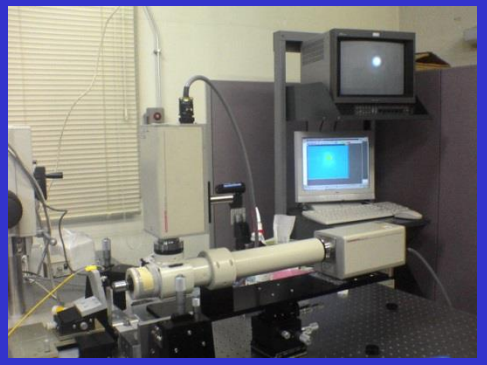
Research on silicon waveguide

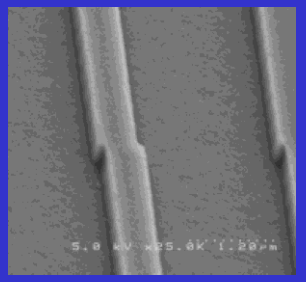
- Application to photonic device of miniaturization and integration which are effective with electronic circuits
- Solved the high loss problem by the introduction of rib optical waveguide structure, opening doors for the possibility of SOI photonics.
- Application of a wire structure with a small usable bending radius facilitates establishment of submicron waveguide creation technology.
- Cost reduction, use of single chip, photoelectron fusion, etc. will expectedly lead to application in future-oriented networks.

Device structure









Reduction of loss and improvement in curvature are our future tasks.

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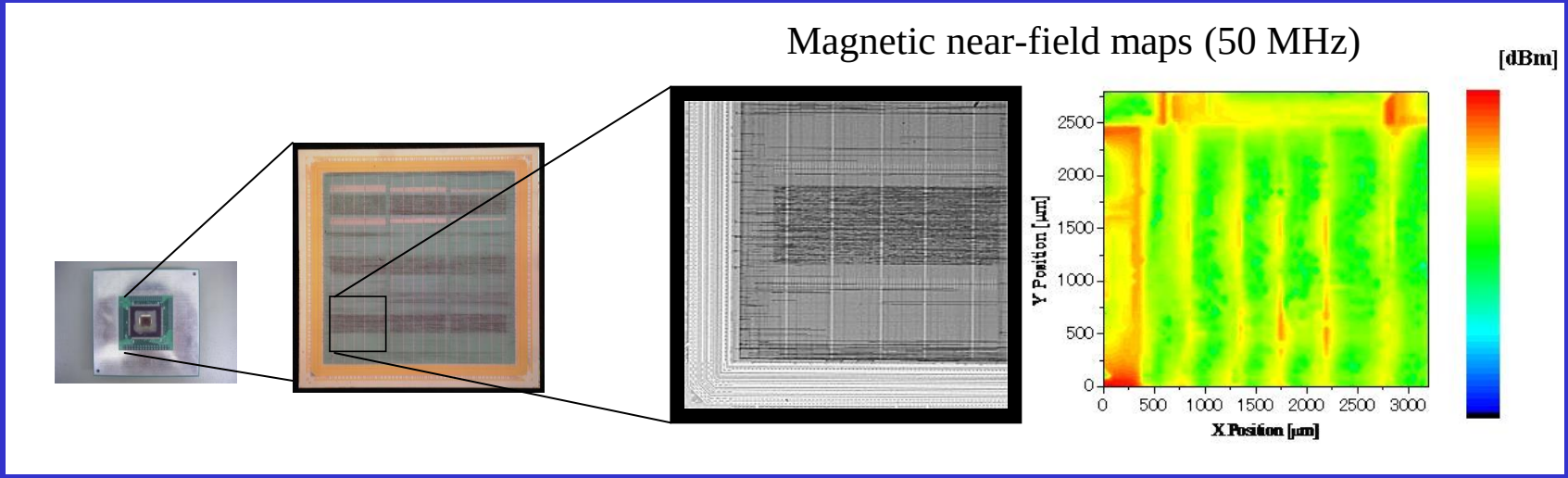
Microcurrent Visualization Technology

Success in visualization of current in IC chips

- Achieved the world's highest spatial resolution.
  (From conventional 1 mm to 10 um)
- World's first current visualization technology that uses magnetic field scanning
  (Possible to measure high-frequency wave magnetic field up to 10 GHz.)



Thank you very much

for your close attention.

Basic and Advanced Research Department
National Institute of Information and Communications Technology

PowerPoint self-presenter

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