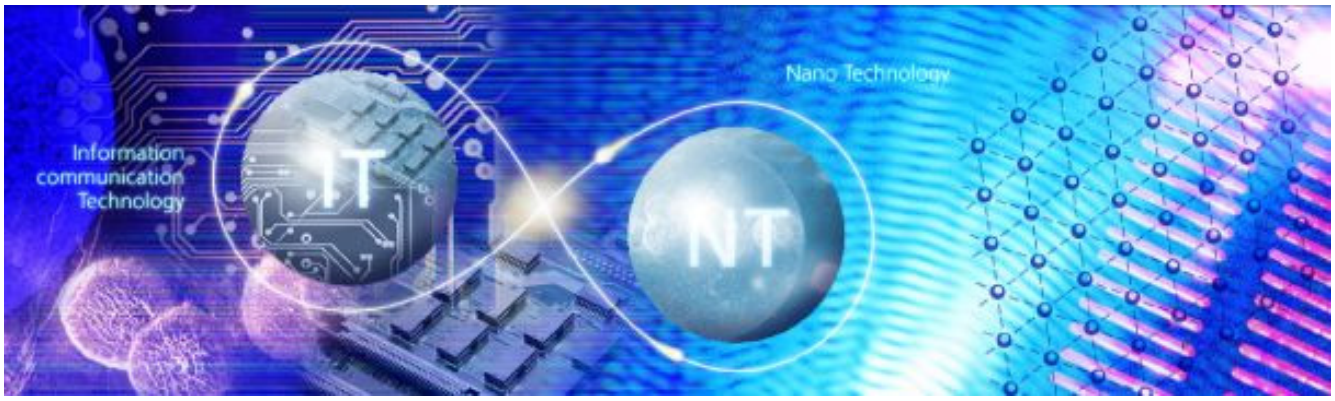
Final Program

IGNOIE-COE05

The 3rd International Symposium on System Construction of Global-Network-Oriented Information Electronics

Tohoku University Electro-Related Departments
21st Century COE Program

January 31 -- February 1, 2006
Sendai Excel Hotel Tokyu, Sendai, Japan
http://www.ecei.tohoku.ac.jp/21coe/ignoie05/



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IGNOIE-COE05 Program at a Glance

Tuesday, January 31, 2006

9:00-9:15	**Opening Remark (Bowl Room A)** Yasutaka Iguchi (Dean of School of Engineering, Tohoku University) Tatsuo Uchida (Chair and Director of the 21st Century COE Program)
9:15-12:00	**Session I: Magnetism & Spintronics (Bowl Room A)** Jian-Ping Wang (Invited) ---------- **Break 10:00-10:15** ---------- Michael E. Flatté (Invited) Hiroaki Muraoka Hideo Ohno Migaku Takahashi
12:00-13:00	**Lunch Break**
13:00-14:25	**Session II: Semiconductors & Displays (I) (Bowl Room A)** Bernd Tillack (Invited) Junichi Murota Fujio Masuoka
14:25-14:35	**Break**
14:35-16:40	**Session III: Semiconductors & Displays (II) (Bowl Room A)** Gérard Ghibaudo (Invited) Tadahiro Ohmi Takahiro Hanyu Kazuo Tsubouchi Tatsuo Uchida
16:40-16:50	**Break**
16:50-18:15	**Session IV: Nanotechnologies -Material & Evaluation- (I) (Bowl Room A)** Konstantinos Giapis (Invited) Rikizo Hatakeyama Michio Niwano
18:20-19:20	**Welcome Reception (Bowl Room B)**

Wednesday, February 1, 2006

9:00-10:00	**Session V: Nanotechnologies -Material & Evaluation- (II) (Bowl Room A)** Junichi Kushibiki Yasuo Cho Yoichi Uehara
10:00-10:15	**Break**
10:15-12:00	**Session VI: Signal Processing & Computing (Bowl Room A)** Yong Ching Lim (Invited) Masayuki Kawamata Hirotomo Aso Shozo Makino
12:00-13:00	**Lunch Break**
13:00-14:25	**Session VII: Optical Devices (Bowl Room A)** Ajay Nahata (Invited) Hiromasa Ito Yuji Matsuura
14:25-14:35	**Break**
14:35-15:40	**Session VIII: Optical Communications (Bowl Room A)** David Richardson (Invited) Masataka Nakazawa
15:40-15:50	**Break**
15:50-17:15	**Session IX: Wireless Communications (Bowl Room A)** Le-Wei Li (Invited) Kunio Sawaya Fumiyuki Adachi
17:15-18:30	**Poster Session (Bowl Room B)**
18:30-20:20	**Banquet (Bowl Room A)**
20:20-20:30	**Closing Remark** Fumiyuki Adachi

Oral Session

Tuesday, January 31, 2006

Bowl Room A

9:00-9:15 Opening Remark

Chair: Simon John Greaves

Greeting (1) **Yasutaka Iguchi**, Professor
Dean of School of Engineering,
Tohoku University

Greeting (2) **Tatsuo Uchida**, Professor
Chair and Director of the 21st Century COE Program,
Tohoku University

Bowl Room A

9:15-12:00 Session I: Magnetism & Spintronics

Chairs: Simon John Greaves and Yuzo Ohno

9:15 Exchange Coupled Composite Media for Perpendicular Magnetic Recording (Invited)

Jian-Ping Wang, Associate Professor (University of Minnesota)

Recently system level simulation showed that traditional perpendicular recording may have a recording areal density limit around 500 Gbit/in^2. A new type magnetic media, exchange coupled composite (ECC) media, was proposed, demonstrated and investigated systematically to extend this limit in this work. The writing capability and thermal stability was proved to be engineered separately based on this new media. Two type ECC media were investigated for the first time: $[Co/PdSiO]_n$ type and $CoCrPtSiO_x$ type. TEM plan-view and cross-section view observations, macromagnetic and micromagnetic testing proved vertically grown magnetic grains with soft and hard regions for ECC media. Much lower switching field was achieved for ECC media while having same thermal stability compared to reference perpendicular media. A much less angle dispersion of the remanent coercivity for the ECC media was found, which is another advantage for such media. ECC media showed better recording performance compared to perpendicular media. Exchange coupling effects between soft and hard regions of magnetic grains in ECC media was investigated and optimized coupling strength was discussed for ECC media. It was found that ECC media could extend the areal density of PMR up to 1 Terabit/in^2.

---------- Break (10:00-10:15) ----------

10:15 Potential Performance of Spin-Based Current-Gating Devices (Invited)

Michael E. Flatté, Professor (University of Iowa)

We compare the fundamental limits of performance of an individual spin-based current-switching device with an individual charge-based current-switching device. All the contacts to each of the devices are assumed to be "incoherent" no quantum mechanical phase relation is maintained by electrons in the contact regions. We find that the use of spin-encoded information within the spin-based current-switching device could permit a room-temperature performance superior to that achievable with the charge-based device. This includes a lower threshold voltage and lower capacitance than on the semiconductor roadmap for field effect transistors for logic through 2018.

11:00 Prototyping of Perpendicular 1-inch Drive and Application to a Wirelessfile Server

Hiroaki Muraoka, Professor

Drive prototyping for 1-inch 10 GBytes HDD using perpendicular magnetic recording was carried out. Perpendicular heads and disks were developed and assembled into the 1-inch drive after servo-writing of the disks. Measurement of error rate performance of the heads and disks showed clear correlation with signal to noise ratio of disks at a high linear density. In addition, the noise was revealed to be transition jitter noise. By using the heads and disks that showed small jitter noise an areal density of 135Gbits/inch2 successfully achieved, which was necessary to realize the capacity of 10 GBytes. Then, a ubiquitous file server that has IEEE802.11g wireless interface was developed as an application of the perpendicular prototype drive. The file server transmitted hivision files with about 15 Mbps transfer rate. Hivision motion pictures with moderate data rates were successfully demonstrated. This work was dealt by the IT21 RR2002 storage project.

11:20 Gate-Control of Dynamic Nuclear Polarization in GaAs/AlGaAs Quantum Wells

Hideo Ohno, Professor

Nuclear spins in semiconductors have attracted great interest because of their long coherence time as well as their compatibility of nano-fabrication technologies for modern electronics. In particular, gate controllability of two-dimensional (2D) electron densities in quantum well (QW) structures is expected to be one of advantages for manipulating hyperfine interactions in semiconductors. Here we demonstrate gate-controlled hyperfine interaction in n-GaAs/AlGaAs QWs. For the observation of temporal 2D electron spin dynamics and the detection of nuclear polarization, a time-resolved Kerr rotation (TRKR) technique is employed.

The experimental results show that the Overhauser effect is enhanced when the back-ground 2D electron density n is decreased to less than 5×10^{11} cm^{-2} by applying the negative voltages to the Schottky gate formed on the sample [1]. The origin of the enhancement/suppression of hyperfine interaction is attributed to the density-dependent electron localization. This scenario is also supported by the fact that the nuclear spin relaxation time changes from ~200 s to ~20 s by decreasing n from metallic to insulating regime.

The work was partly supported by JST, MEXT and JSPS.
[1] H. Sanada, S. Matsuzaka, K. Morita, C.Y. Hu, Y. Ohno, and H. Ohno, Phys. Rev. Lett. 94, 097601 (2005).

11:40 Tailor-Made Nano Structured Material for High Density Spin Storage Device

Migaku Takahashi, Professor

Due to spread of ubiquitous network, information all over the world is exchanged multi-directionally and instantaneously. Our main goal is to open a way to realize ultra high density spin storage devices with fast operation speed at very high-frequency range utilizing a spin nano-technology. For realizing spintronics storage devices, precisely controlled fabrication technology with nano-scale according to the required properties in each device is essential from material, processes, and physical view point. The control of ultra-thin thickness, surface morphology, grain size, and oxidization process is a required key issue for magnetoresistive random access memory (MRAM) with tunnel magnetoresistance (TMR) or spin valve (SV) head with giant magnetoresistance (GMR) for hard disk drives (HDD). The control of domain structure in soft-magnetic underlayer (SUL) and narrower size distribution of the magnetic particle in recording layer are indispensable for advanced storage media with high S/N ratio and thermal stability.

Ultra clean (UC) dry-process proposed by us has provided fruitful results on film growth of seed, magnetic, and oxide layers for the current HD, MRAM and SV head with high TMR and GMR ratio. While, we have proposed new concept and material as underlayer instead of conventional SUL for HD with perpendicular magnetic recording media. Furthermore, mono-dispersed magnetic nanoparticle array fabricated by a chemical synthesis with self-assembly can be a promising key technology to realize thin-film magnetic recording storage media with ultra high density limit beyond ~1Tbit/inch2. Within the frame work of the present paper, correlation between process parameter and magnetic property developed for each categorized research items mentioned above will be widely discussed in connection with spin storage devices.

---------- Lunch Break (12:00-13:00) ----------

Bowl Room A

13:00-14:25 Session II: Semiconductors & Displays (I)

Chair: Masao Sakuraba

13:00 Atomic Layer Processing for Future Micro- and Nanotechnology (Invited)

Bernd Tillack, Manager (IHP)

Future nanoscaling and nanotechnology is requiring atomic-order control of process technology for device fabrication. Here we show the concept of atomic-level processing based on atomic-order surface reaction control for doping of SiGe. The main idea of the atomic layer approach is the separation of the surface adsorption of reactant gases from the reaction process. By this way the process is controlled by the surface adsorption equilibrium only. Self-limiting processes at atomic level and very low process temperature (even room temperature) have been shown for epitaxy (Si, Ge) and doping [1,2,3]. Atomic level control of P, B, and C doping of SiGe films were obtained using Low Pressure and Reduced Pressure CVD in single wafer reactors. In the case of B atomic layer doping the process has been found to be self-limiting at low temperatures (100 - 200°C). Very steep B profiles have been obtained (1 nm/dec). Low sheet resistance (< 1kΩ/sq) at depth between 10 and 20 nm show the capability of the atomic layer doping approach for ultra shallow junction fabrication. For P and C atomic layer doping self-limitation of the process has been observed for the temperature range investigated (room temperature – about 450°C). B and P atomic layer doping has been used for base doping of npn and pnp heterojunction bipolar transistors. By this way the capability of the atomic layer doping approach has been demonstrated for devices with critical requirements for dopant dose and location control.

[1] B.Tillack et al., Thin Sol. Films, 369 (2000) 189.
[2] J.Murota, M.Sakuraba, Surf. Interface Anal., 34 (2002) 423.
[3] B.Tillack et al., Appl. Surf. Science, 224 (2004) 55.

13:45 Atomically Controlled Processing for Future Si-Based Devices

Junichi Murota, Professor

Atomically controlled processing has become indispensable for the fabrication of Si-based ultrasmall devices and Si-based heterodevices, because high performance Si-based devices require atomic-order abrupt heterointerfaces and doping profiles. Our concept of atomically controlled processing is based on atomic-order surface reaction control. The final goal is the generalization of the atomic-order surface reaction processes and the creation of new properties in Si-based ultimate small structures which will lead to nanometer scale Si devices as well as Si-based quantum devices. Plasma assisted process is one of the candidates as a very-low-temperature growth of heterostructure with an abrupt heterointerface. By the electron-cyclotron resonance Ar plasma enhanced chemical vapor deposition, Si and Ge epitaxial growth on Si(100) were achieved without substrate heating using SiH_4 and GeH_4 respectively. In the nitrogen plasma irradiation to Si(100), it is suggested that the nitridation of the deeper Si atoms below surface is enhanced with increasing ion energy as well as the Si surface temperature. Si epitaxial growth on atomic-order nitrided Si(100) was also achieved without substrate heating, and it is confirmed that N atoms of about 0.8 atomic layer are confined within about 3nm-thick region under the present accuracy. These results open the way to atomically controlled processing at around room temperature.

14:05 Impact of Surrounding Gate Transistor (SGT) on Future High Density ULSI

Fujio Masuoka, Professor

Surrounding Gate Transistor (SGT) will be able to improve the performance of ULSI. The SGT arranges source, gate and drain vertically. The gate electrode surrounds a silicon pillar island. The channel region exists at the surface of the sidewalls of the pillar silicon island. The SGT has a large effective channel width even in a small occupied area. Because all the sidewall of the pillar silicon island can be used as a transistor channel. Accordingly, the SGT offers high-shrinkage feature. By using SGT the occupied area of the ULSI can be shrunk to 10% of that by using conventional planar transistor. The small occupied area leads to the small capacitance and the small load resistance. Moreover the current drivability of SGT is larger than that of the conventional planar transistor. Therefore, high speed and low power operation can be achieved by SGT.

---------- Break (14:25-14:35) ----------

Bowl Room A

14:35-16:40 Session III: Semiconductors & Displays (II)

Chair: Kouji Kotani

14:35 Low Frequency Noise in Advanced CMOS Devices (Invited)

Gérard Ghibaudo, Professor (IMEP, ENSERG)

A review of recent results concerning the low frequency noise in advanced CMOS devices will be given. The approaches such as the carrier number and the Hooge mobility fluctuations used for the analysis of the noise sources will first be presented and illustrated through experimental data obtained on advanced CMOS SOI and Si bulk generations. For SOI devices, a particular attention will be paid to the fully-depleted MOS FET's and double-gate structure emphasizing the floating body and coupling effects. For bulk Si, the impact of device scaling and gate leakage on LF noise and RTS fluctuations will be addressed.

15:20 High-Performance Three-Dimensional MISFET Device Fabricated by Using Damage-Free Plasma Process Technology

Tadahiro Ohmi, Professor

Damage-free microwave-excited low-electron temperature and high-density plasma process technology is realized. The technology is applied to fabrication of high-performance three-dimensional SOI MISFET for the first time. The devices, which are operated at accumulation-mode in order to improve the effective mobility and 1/f noise characteristics, show the ideal device characteristics and drastically improvement of current drivability because microwave-excited plasma can form high-quality gate insulator film on any surface orientations of silicon surface due to highly reactive radicals. Damage-free microwave-excited plasma etching process, which can realize low source/drain contact resistance with simple process steps, is also developed because lowering of source/drain resistance is essential for such devices to keep actual performance of current drivability.

15:40 Multiple-Valued Asynchronous Data Transfer Scheme and Its Application

Takahiro Hanyu, Professor

A novel asynchronous data-transfer scheme based on multiple-valued encoding is proposed for clockless high-speed intra-chip communication. Since control signals and data from mutual nodes are multiplexed using a multi-level dual-rail codeword, the number of communication steps can be greatly reduced, which results in high-speed communication without any additional wires. The hardware is simply implemented by utilizing a multiple-valued current-mode circuit because all the information can be superposed on the same line. As a typical application, a high-throughput interleaver in Low-Density Parity-Check (LDPC) decoding is designed using the proposed circuit technique, and its advantages are discussed in comparison with a conventional interleaver based on a synchronous data-transfer scheme.

16:00 Ubiquitous Network and Devices

Kazuo Tsubouchi, Professor

Wireless cellular infrastructures provided by major common carriers have been constantly expanding their services and making technological advancement. In the near future, wireless internet-protocol (IP) packet network with high-speed burst transmission, easy installation and low-cost will be required in addition to the infrastructures. In burst transmission, phase of received signal has phase distortion due to carrier frequency offset between transmitter and receiver. Without frequency offset compensation, incorrect demodulation occurs due to the phase distortion of the received signal. A receiver of digital wireless cellular communication system has automatic frequency control (AFC) circuit for carrier frequency offset compensation. Since a conventional AFC circuit is designed for continuous transmission signal, the conventional AFC circuit cannot achieve rapid carrier frequency offset compensation for the burst transmission. In this paper, we have proposed new carrier frequency offset compensation scheme for the burst transmission. Key functions of proposed scheme are insertion of the pilot signals to information block for evaluation of offset and polar-coordinates conversion scheme using read only memory (ROM) for phase compensation.

16:20 Development of High Quality and Low Power Color-Field Sequential OCB-mode LCD

Tatsuo Uchida, Professor

With a growth of information technologies, a role of display has become important. Liquid crystal displays (LCDs) have been widely used as a PC monitors, PDAs and TVs because of its low power, thin profile and light weight. A future display is required to have a capability of high quality moving-image and ultra low-power consumption. A color-field sequential refreshing (CFS) method is one of the most promising solutions, since it eliminates the loss at the color filters of ordinary LCDs. This method requires a fast response LC cell. Therefore, we employed an optically compensated bend (OCB) mode LC cell. The polarization properties of liquid crystal and the diffusion characteristics in the optical films are investigated and we newly investigated a "Polarized Light Control theory (PLC theory)" and a "Diffused Light Control theory (DLC theory)" for design of OCB-mode LC cell. In addition, we invented a “Rubbing Shadow Domain method (RSD method)” to form the nucleus for an initial transition in OCB-mode LC cell. These fundamental theories result in a high performance CFS OCB-mode LCD with ultra low power consumption, wide viewing angle and high contrast ratio.

---------- Break (16:40-16:50) ----------

Bowl Room A

16:50-18:15 Session IV: Nanotechnologies - Material & Evaluation - (I)

Chair: Toshiro Kaneko

16:50 Nanoparticles and Nanocoatings from Plasmas: New Challenges and Opportunities (Invited)

Konstantinos Giapis, Associate Professor (California Institute of Technology)

The formation of particles in processing plasmas has generally been related to contamination and lower yields and is considered undesirable. However, nanometer-size particles can have unusual properties, very different from those of bulk materials, which makes them attractive for nanotechnology applications. We have explored the formation of Si nano-particles in continuous-flow atmospheric-pressure dc microdischarges confined in capillary tubes. The intensity and size of these discharges permits the rapid decomposition of silane, leading to nucleation and growth of 1-3 nm Si particles, whose growth is abruptly terminated as they exit the microreactor. Narrow size distributions are obtained as inferred from classification and imaging. Particles of both charge polarities are detected with similar size distribution but 2X more positively charged particles. As grown Si particles luminesce in the blue (420nm) with a quantum efficiency of 30% and may find applications in imaging and Si-based optoelectronics. The microdischarge synthesis route is generic to any gas-phase precursor and has been also used to grow Ge and Fe nanoparticles of 1-3 nm in size in benchtop setups. Nanowires and nanotubes are promising as nanoprobes, provided they can be coated with insulating materials followed up by tip end exposure and functionalization. We have used inductively-coupled plasmas to deposit conformal fluorocarbon coatings of a few nm thickness on carbon nanotubes. The coatings provide good insulation while they improve the rigidity of the nanotubes for surface imaging. We will present results from probe immersion experiments in Hg and water. Plasmas provide a versatile way to deposit a wide variety of extremely thin coatings to enable passivation, isolation, or functionalization at the nanoscale.

17:35 Novel-Structured and -Functional Nanocarbons Created by Nanoscopic Plasma Surface-Process Control

Rikizo Hatakeyama, Professor

Original approaches using nanoscopic plasma processes have been performed in order to develop C_{60}(Fullerene)- and SWNT(single-walled carbon nanotube)-based materials with new functions relating to nanoelectronics. Two kinds of macro-quantity synthesis methods for $N@C_{60}$ which encapsulates an atomic nitrogen inside the empty C_{60} are developed using electron-cyclotron resonance and double-magnetron discharge plasmas. Electron-spin resonance measurements indicate the largest value of over 0.01 % in the synthesis purity. Concerning the latter we have proposed a diffusion plasma-enhanced chemical vapor deposition method, by which individually-isolated and vertically-aligned SWNTs are successfully produced on a flat-surface substrate. In relation to the inner nanospace control of such pristine SWNTs, based on the formation of alkali-metals encapsulated SWNTs (A@SWNTs) using the substrate-bias method in alkali-metal plasmas, electronic transport measurements reveal that Cs@SWNT retains the air-stability with an n-type semiconducting property in contrast to the pristine-SWNT property while Li@SWNT exhibits ambipolar (p- and n-type) transport behavior. In addition we have started to perform experiments on the formation of ferromagnetic atoms encapsulated SWNTs using thermal and plasma combined-processes. Finally we have succeeded in the formation of DNA encapsulated SWNTs (DNA@SWNTs) using electrolyte micro plasmas in solution, where radio-frequency and direct-current electric fields are superimposed in order to stretch random-coiled DNA and transfer DNA negative ions toward pristine SWNTs.

17:55 Doping Effect of Organic Thin Film Transistors

Michio Niwano, Professor

In order to elucidate the mechanism of the so-called doping effect of organic thin-film transistors (OTFTs), we have investigated the effects of oxygen exposure and light illumination on OTFTs. We used displacement current measurement (DCM) to probe the charge carrier behavior at organic/dielectric interfaces and infrared absorption spectroscopy in the multiple internal reflection geometry (MIR-IRAS) to monitor chemical changes of organic thin-film layers caused by the doping effect. The organic materials we used are pentacene and poly-3-hexylthiophene (P3HT). DCM data showed that the oxygen doping effect is small in dark condition, but is significantly enhanced under light illumination (photo-induced doping). Therefore, we concluded that light illumination is a key factor to the doping effect. MIR-IRAS results revealed that the charge-transfer reaction is promoted by the light illumination.

Bowl Room B

18:20-19:20 Welcome Reception

Wednesday, February 1, 2006

Bowl Room A

9:00-10:00 Session V: Nanotechnologies - Material & Evaluation - (II)

Chair: Hiroyuki Odagawa

9:00 Application of the Line-Focus-Beam Ultrasonic Material Characterization System to Evaluation of TiO_2-SiO_2 Ultra-Low-Expansion Glasses

Junichi Kushibiki, Professor

The line-focus-beam ultrasonic material characterization (LFB-UMC) system was applied to evaluation of TiO_2-doped SiO_2 ultra-low-expansion glass having periodic striae associated with its fabrication process. A coefficient of thermal expansion (CTE) of the TiO_2-SiO_2 glass is controlled by changing the concentration of TiO_2. A standard specimen was needed for calibrating the LFB-UMC system, and a proper preparation of the standard specimen and a proper measurement method were investigated. Consequently, it was clarified that a specimen substrate with a surface perpendicular to the striae plane is suitable for the standard specimen and a reliable standard value can be obtained by measuring the velocity for leaky surface acoustic wave (LSAW) propagation parallel to the striae plane on the standard specimen surface. Also, we determined the accurate relationship between the TiO_2 concentrations and LSAW velocities so that we can absolutely evaluate TiO_2 concentrations of the glasses through the LSAW velocity measurements. Furthermore, to evaluate more reliably the more homogeneous ultra-low-expansion glasses in the near future, the measurement accuracy of the LSAW velocity was improved with a method using lower frequency. This ultrasonic method is extremely promising for the development of the ultra-low expansion glass to realize extreme ultra-violet lithography (EUVL) systems in the next generation semiconductor nano-electronics.

9:20 Ferroelectric Data Storage with 10 Tbit/inch^2 Memory Density and Sub Nano-Second Domain Switching Time

Yasuo Cho, Professor

Nano-sized inverted domain dots in ferroelectric materials have potential application in ultrahigh-density rewritable data storage systems. Herein, a data storage system is presented based on scanning nonlinear dielectric microscopy and a thin film of ferroelectric single-crystal lithium tantalite. Through domain engineering, nano-sized inverted domain dots have been successfully formed at a data density above 10.1 Tbit/in.^{2} and sub-nanosecond (500psec) domain switching speed has been achieved. Moreover, actual information storage is demonstrated at a density of 1 Tbit/in.^{2}.

9:40 Scanning Tunneling Microscope Light Emission Spectroscopy of Aggregated Molecules

Yoichi Uehara, Professor

Many light emitting molecules come to show different optical properties after aggregation. Elucidation of this aggregation effect is important not only from the view point of scientific interest but also from the view point of molecular engineering. By virtue of the high spatial resolution of scanning tunneling microscope (STM), one can distinguish between individual single and aggregated molecules in the STM image. Furthermore the light emission spectrum of a single molecule itself can be determined by the STM light emission spectroscopy. Thus STM light emission measurements are very useful for optical investigations of aggregated molecules. We investigated the optical properties of aggregated Erythrosin B molecules on highly oriented pyrolytic graphite. We have measured the STM light emission spectra of individual aggregates whose number of constituent molecules were determined from the STM image. It was found that the aggregation effect between the two- and four-molecule aggregates is much more marked than that between the two-molecule aggregate and single molecule.

---------- Break (10:00-10:15) ----------

Bowl Room A

10:15-12:00 Session VI: Signal Processing & Computing

Chair: Masahide Abe

10:15 Computationally Efficient Digital Filters (Invited)

Yong Ching Lim, Professor (Nanyang Technological University)

The computational efficiency of a digital filter is measured by the arithmetic complexity required to achieve a given set of filter specifications. The lower is the arithmetic complexity the higher is the computational efficiency. Computationally more efficient filters require less silicon area, consume less power, and operate at higher frequencies when implemented on VLSI. Several methods for improving the computational efficiency of digital filters are presented in this paper. These include (a) predictive coding, (b) extrapolated impulse response, (c) powers-of-two, and (d) sparse coefficient techniques. Depending on circumstances, several of the above techniques may be used simultaneously to achieve even higher computational efficiency.

11:00 Linear System Theory from a Signal Processing Point of View

Masayuki Kawamata, Professor

This paper gives a new look at linear sate-space systems from a signal processing point of view. We first discuss the invariance property of second order modes of linear systems under frequency transformation and the complement property of the controllability grammian and the observability grammian of a pair of power complementary systems. Frequency transformation and power complementary concepts are well-known in the frequency domain of signal processing field. We next introduce their corresponding properties in the time domain using the state-space formulation, especially using the controllability and observability grammians and the second-order modes.

11:20 Self-Learning Architecture for Web Image Documents

Hirotomo Aso, Professor

There are many image documents in the world wide web system. Recognition of such documents is necessary to utilize knowledge and information in WWW system. A self-learning architecture is proposed to realize the more correct recognition of image documents.

11:40 Advanced Multi-Modal Processings for Small Size Devices Used in New Generation Electronics

Shozo Makino, Professor

Speech and image are very important input/output media for small size devices such as PDA and a mobile phone used in new generation information electronics system. In order to develop a high-accuracy speech and image recognition and understanding system, in this year, we have carried out the researches concerning to the following five topics.1) A human and machine communication system using speech and image: We have developed a discrimination system among laugh, smile and normal based on speech and face recognition, 2) Robust speech recognition system for various kinds of speech: We have constructed a noise robust speech recognition system in which each distribution of each node in phoneme HMM represents a single kind of noise, 3) A portable spoken dialog system for a small task: We have refined on a Bunsetsu model and a generation model of utterance candidates, 4) CALL system for non-native speakers based on speech recognition: We have refined on a detection method of error-pronunciation, and 5) Music information retrieval system with query-by-song using error tolerant melody matching: As we have not used lyrics for music information retrieval yet, we introduced recognition of lyrics using speech recognition.

---------- Lunch Break (12:00-13:00) ----------

Bowl Room A

13:00-14:25 Session VII: Optical Devices

Chair: Junichi Shikata

13:00 Enhanced Transmission through a Single Subwavelength Aperture and Its Application to Arbitrary Terahertz Waveform Generation (Invited)

Ajay Nahata, Associate Professor (University of Utah)

We have measured the enhanced transmission properties of a single subwavelength aperture surrounded by periodically spaced annular grooves using time-domain techniques. While the present measurements are performed at terahertz frequencies, with appropriately scaled device parameters, the general observations should be applicable to other spectral ranges. In contrast to measurements that rely on continuous wave excitation and frequency domain measurements, we are able to determine the contribution of each individual groove to the transmitted terahertz waveform. Using this information, we demonstrate the ability to alter the pulse shape of an incident single cycle THz pulse. Thus, arbitrarily complex time-domain waveforms may be generated, in principle. We discuss several proof-of-principle applications based on this capability.

13:45 Frequency-Agile THz-Wave Parametric Oscillator/Generator

Hiromasa Ito, Professor

The spectrum of the THz radiation is well matched to the low-frequency motions important for the function of many biological molecules. THz pulsed imaging and spectroscopy are powerful techniques to explore a frontier in the field of biological, chemical, pharmaceutical applications. For these purposes enormous efforts are made to establish high quality tunable monochromatic terahertz (THz)-wave sources using optical parametric process. Frequency-agile THz-wave parametric oscillator (TPO) using $LiNbO_3$ ring cavity configuration pumped by a Q-switched Nd:YAG laser is well suited for THz imaging and spectroscopy applications. Difference frequency generation (DFG) also covers tremendously wide range of THz spectra. Organic nonlinear crystal DAST grown by our laboratory is one of the best materials, which is collinearly phase-matched between 1 THz (300μm) to 40 THz (7.5μm). Continuous THz-wave DFG is also discussed using periodically poled $LiNbO_3$.

14:05 Hollow Optical Waveguides for Extreme Wavelengths –Soft X-ray, Extreme Ultraviolet, and Terahertz Regions

Yuji Matsuura, Associate Professor

Specialty fiberoptics based on hollow optical waveguides are proposed and developed for transmission of soft X-ray, extreme-ultraviolet (EUV), and terahertz radiation. For X ray and EUV, glass capillaries with inner metal coating show high transmission efficiency when a proper material for the target wavelength is chosen as an inner metal layer. Highly-flexible, hollow molybdenum waveguides with a length of 30 cm show more than 10% transmission at a wavelength of 0.25 nm. For EUV of around 13 nm wavelength, transmission properties of a silver-coated hollow fiberoptics are evaluated by using a laser-induced plasma X-ray source. Similar metal-coated hollow waveguides and hollow fibers with a dielectric inner layer are chosen for terahertz region. The metal-coated waveguide with an inner diameter of 1.0 mm delivers TE11 mode at an optical loss of around 8 dB/m. The dielectric-coated fiber shows much lower attenuation by supporting HE11 mode transmission.

---------- Break (14:25-14:35) ----------

Bowl Room A

14:35-15:40 Session VIII: Optical Communications

Chair: Toshihiko Hirooka

14:35 Recent Developments in Fibre Technology and Its Application Within High Speed Optical Communications (Invited)

David Richardson, Professor (University of Southampton)

Recent advances in optical fibre technology, most notably in the area of microstructured fibres, high power rare-earth doped fibres, and superstructured fibre Bragg gratings offer a host of new opportunities within future high speed communication systems. Within this talk I shall review the increased range of waveguide characteristics that can now be addressed with an emphasis on both fibre nonlinearity and dispersion control, describe the developments that have allowed the realisation of high power fibre lasers and amplifiers capable of operating at kW average power levels, and describe the latest advances in the design and fabrication of fibre Bragg gratings for the manipulation and shaping of ultrashort pulses. I shall then describe how such components can be integrated into various all-optical processing devices for high speed optical communication systems. Applications covered shall include optical regeneration, wavelength conversion, data format conversion and OTDM add-drop multiplexing. Finally, I shall speculate as to likely future developments and applications of the technology beyond telecommunications.

15:20 Distortion-Free Pulse Transmission Using Time-Domain Optical Fourier Transformation: ABCD Matrix Formalism and Its All Optical Technology

Masataka Nakazawa, Professor

To achieve an ultrahigh-speed optical network, it is very important to establish an optical pulse control technology that enables us to transmit ultrashort pulses without distortion. The first part of this talk consists of an analytical description of distortion-free transmission using time-domain optical Fourier transformation (OFT) that employs a time-domain ABCD matrix formalism. The analysis is based on an analogy with a spatial Fourier transformation in diffraction through lenses. The theory enables us to derive the pulse width and chirp at the OFT output explicitly and to evaluate the effect of dispersion inaccuracy in OFT by using only simple algebra. In the latter part of the talk, I describe the possibility of all-optical OFT with the use of parabolic optical pulses and optical cross phase modulation in optical fibers. Parabolic pulses can be generated by using nonlinear pulse evolution in a dispersion-decreasing normal dispersion fiber. Cross phase modulation between a parabolic optical pulse and an optical data signal in a dispersion-flattened, zero dispersion fiber followed by a proper GVD fiber enables us to achieve high-speed all-optical OFT.

---------- Break (15:40-15:50) ----------

Bowl Room A

15:50-17:15 Session IX: Wireless Communications

Chair: Hiroyasu Sato

15:50 Fast Algorithms for Electromagnetic Scattering and Antenna Radiation (Invited)

Le-Wei Li, Professor (National University of Singapore)

This paper presents some recent developments of efficient and fast solvers developed based on two major integral equation techniques, namely, the adaptive integral method (AIM), and the pre-corrected Fast Fourier transform (pFFT) method. It will also present some applications for characterizing electromagnetic scattering by arbitrarily shaped objects, and designing antennas for large scaled radio radiation problems. Although a brief summary of the historical development will be given, the emphasis of the paper will be given to the recent advances and new developments made quite recently. During the development procedure, the method of moments (MoM) has been considered and applied as a foundation to start with for discretizing the integral equations. The resultant matrix system of a large dimension is then solved by an iterative solver where the adaptive integral method (AIM) and the pre-corrected Fast Fourier transform (pFFT) method are employed on the top of them to accelerate the matrix-vector multiplications and to reduce matrix storage. Various numerical results are presented to demonstrate the accuracy, efficiency, and applicability of the technique.

16:35 Long Range Passive RFID-Tag

Kunio Sawaya, Professor

RFID systems have been applied to many systems as the identification and tracking techniques. The RFID tags are required to be compact, low price and long life without any maintenance, and high efficiency for long range applications. In this report, passive RFID tags for a range longer than 20 m are proposed for 4W EIRP system at 950 MHz band and RCR STD-1 specification at 2.45 GHz band. Fabricated RFID tags have sizes of 90 by 60 by 4 mm and 60 by 26 by 4 mm for 900 MHz and 2.45 GHz bands, respectively, and applied to monitor system of temperature.

16:55 Broadband Wireless Techniques Based on Frequency-domain Signal Processing

Fumiyuki Adachi, Professor

A very high-speed data transmission of 100Mbps-to-1Gbps is required for the next generation wireless networks. However, such high-speed signal transmission performance is severely degraded due to frequency-selective fading caused by the presence of many interfering propagation paths with different time delays. Code division multiple access (CDMA) with frequency-domain equalization can overcome and even take advantage of the channel frequency-selectivity to improve the transmission performance. In wireless communications, the transmission performance is also limited by the multi-access interference (MAI) since many users access a base station at the same time. To reduce the MAI, frequency-interleaving or two-dimensional spreading can be jointly used with frequency-domain equalization. However, a 1Gbps transmission with a limited bandwidth is only possible by the use of multi-input multi-output (MIMO) antenna technique. We introduce the frequency-domain signal processing to CDMA and MIMO. Our recent research activity about these techniques is presented.

Bowl Room B

17:15-18:30	**Poster Session**	(abstracts: see next page)

Chair: Takahiro Ishinabe

Bowl Room A

18:30-20:20	**Banquet**	
20:20-20:30	**Closing Remark**	Fumiyuki Adachi

Chair: Simon John Greaves

Poster Session

Bowl Room B

Wednesday, February 1, 2006

17:15-18:30

Prototyping of Perpendicular 1-inch Drive and Application to a Wirelessfile Server

Hiroaki Muraoka, Professor

Drive prototyping for 1-inch 10 GBytes HDD using perpendicular magnetic recording was carried out. Perpendicular heads and disks were developed and assembled into the 1-inch drive after servo-writing of the disks. Measurement of error rate performance of the heads and disks showed clear correlation with signal to noise ratio of disks at a high linear density. In addition, the noise was revealed to be transition jitter noise. By using the heads and disks that showed small jitter noise an areal density of 135Gbits/inch2 successfully achieved, which was necessary to realize the capacity of 10 GBytes. Then, a ubiquitous file server that has IEEE802.11g wireless interface was developed as an application of the perpendicular prototype drive. The file server transmitted hivision files with about 15 Mbps transfer rate. Hivision motion pictures with moderate data rates were successfully demonstrated. This work was dealt by the IT21 RR2002 storage project.

Semiconductor Spintronics

Hideo Ohno, Professor

We are exploring new functionality utilizing both charge and spin degrees of freedom to realize novel functional devices and quantum information technologies in III-V based ferromagnetic/non-magnetic semiconductor heterostructures. Here we present current-driven magnetization reversal and the domain wall dynamics in ferromagnetic semiconductor (Ga,Mn)As thin films, which are expected to provide a new-class of magnetization switching technologies. We also demonstrate gate-controlled dynamic nuclear polarization in n-GaAs/AlGaAs quantum wells by a time-resolved Kerr rotation technique. This will be of assistance for efficient initialization or manipulation of quantum bit in semiconductor based nuclear spin quantum computers.

Tailor-Made Nano Structured Material for High Density Spin Storage Device

Migaku Takahashi, Professor

Due to spread of ubiquitous network, information all over the world is exchanged multi-directionally and instantaneously. Our main goal is to open a way to realize ultra high density spin storage devices with fast operation speed at very high-frequency range utilizing a spin nano-technology. For realizing spintronics storage devices, precisely controlled fabrication technology with nano-scale according to the required properties in each device is essential from material, processes, and physical view point. The control of ultra-thin thickness, surface morphology, grain size, and oxidization process is a required key issue for magnetoresistive random access memory (MRAM) with tunnel magnetoresistance (TMR) or spin valve (SV) head with giant magnetoresistance (GMR) for hard disk drives (HDD). The control of domain structure in soft-magnetic underlayer (SUL) and narrower size distribution of the magnetic particle in recording layer are indispensable for advanced storage media with high S/N ratio and thermal stability.

Ultra clean (UC) dry-process proposed by us has provided fruitful results on film growth of seed, magnetic, and oxide layers for the current HD, MRAM and SV head with high TMR and GMR ratio. While, we have proposed new concept and material as underlayer instead of conventional SUL for HD with perpendicular magnetic recording media. Furthermore, mono-dispersed magnetic nanoparticle array fabricated by a chemical synthesis with self-assembly can be a promising key technology to realize thin-film magnetic recording storage media with ultra high density limit beyond ~1Tbit/inch2. Within the frame work of the present paper, correlation between process parameter and magnetic property developed for each categorized research items mentioned above will be widely discussed in connection with spin storage devices.

Atomically Controlled Processing for Future Si-Based Devices

Junichi Murota, Professor

Atomically controlled processing has become indispensable for the fabrication of Si-based ultrasmall devices and Si-based heterodevices, because high performance Si-based devices require atomic-order abrupt heterointerfaces and doping profiles. Our concept of atomically controlled processing is based on atomic-order surface reaction control. The final goal is the generalization of the atomic-order surface reaction processes and the creation of new properties in Si-based ultimate small structures which will lead to nanometer scale Si devices as well as Si-based quantum devices. Plasma assisted process is one of the candidates as a very-low-temperature growth of heterostructure with an abrupt heterointerface. By the electron-cyclotron resonance Ar plasma enhanced chemical vapor deposition, Si and Ge epitaxial growth on Si(100) were achieved without substrate heating using SiH_4 and GeH_4 respectively. In the nitrogen plasma irradiation to Si(100), it is suggested that the nitridation of the deeper Si atoms below surface is enhanced with increasing ion energy as well as the Si surface temperature. Si epitaxial growth on atomic-order nitrided Si(100) was also achieved without substrate heating, and it is confirmed that N atoms of about 0.8 atomic layer are confined within about 3nm-thick region under the present accuracy. These results open the way to atomically controlled processing at around room temperature.

Impact of Surrounding Gate Transistor (SGT) on Future High Density ULSI

Fujio Masuoka, Professor

Surrounding Gate Transistor (SGT) will be able to improve the performance of ULSI. The SGT arranges source, gate and drain vertically. The gate electrode surrounds a silicon pillar island. The channel region exists at the surface of the sidewalls of the pillar silicon island. The SGT has a large effective channel width even in a small occupied area. Because all the sidewall of the pillar silicon island can be used as a transistor channel. Accordingly, the SGT offers high-shrinkage feature. By using SGT the occupied area of the ULSI can be shrunk to 10% of that by using conventional planar transistor. The small occupied area leads to the small capacitance and the small load resistance. Moreover the current drivability of SGT is larger than that of the conventional planar transistor. Therefore, high speed and low power operation can be achieved by SGT.

High-Performance Three-Dimensional MISFET Device Fabricated by Using Damage-Free Plasma Process Technology

Tadahiro Ohmi, Professor

Damage-free microwave-excited low-electron temperature and high-density plasma process technology is realized. The technology is applied to fabrication of high-performance three-dimensional SOI MISFET for the first time. The devices, which are operated at accumulation-mode in order to improve the effective mobility and 1/f noise characteristics, show the ideal device characteristics and drastically improvement of current drivability because microwave-excited plasma can form high-quality gate insulator film on any surface orientations of silicon surface due to highly reactive radicals. Damage-free microwave-excited plasma etching process, which can realize low source/drain contact resistance with simple process steps, is also developed because lowering of source/drain resistance is essential for such devices to keep actual performance of current drivability.

Multiple-Valued Asynchronous Data Transfer Scheme and Its Application

Takahiro Hanyu, Professor

A novel asynchronous data-transfer scheme based on multiple-valued encoding is proposed for clockless high-speed intra-chip communication. Since control signals and data from mutual nodes are multiplexed using a multi-level dual-rail codeword, the number of communication steps can be greatly reduced, which results in high-speed communication without any additional wires. The hardware is simply implemented by utilizing a multiple-valued current-mode circuit because all the information can be superposed on the same line. As a typical application, a high-throughput interleaver in Low-Density Parity-Check (LDPC) decoding is designed using the proposed circuit technique, and its advantages are discussed in comparison with a conventional interleaver based on a synchronous data-transfer scheme.

Seamless Handover for Hotspot Network

Kazuo Tsubouchi, Professor

We have proposed hotspot network based on layer 2 forwarding for seamless handover. Key functions of the proposed hotspot network are movement notification packet sending for changing forwarding path and adaptive flow control at handover for keeping throughput. A mobile terminal sends the movement notification packet in order to change address table in nodes of the hotspot network after changing connection from previous access point to new access point. To realize adaptive flow control, mobile terminal controls transmission control protocol (TCP) offered window size. The mobile terminal closes the offered window before handover and opens the window after handover. We have evaluated performance of the proposed network using network test bench. IEEE802.11b modems were used as wireless interfaces. The degradation of throughput at handover was reduced compared with that of conventional method without adaptive flow control.

Development of High Quality and Low Power Color-Field Sequential OCB-mode LCD

Tatsuo Uchida, Professor

With a growth of information technologies, a role of display has become important. Liquid crystal displays (LCDs) have been widely used as a PC monitors, PDAs and TVs because of its low power, thin profile and light weight. A future display is required to have a capability of high quality moving-image and ultra low-power consumption. A color-field sequential refreshing (CFS) method is one of the most promising solutions, since it eliminates the loss at the color filters of ordinary LCDs. This method requires a fast response LC cell. Therefore, we employed an optically compensated bend (OCB) mode LC cell. The polarization properties of liquid crystal and the diffusion characteristics in the optical films are investigated and we newly investigated a "Polarized Light Control theory (PLC theory)" and a "Diffused Light Control theory (DLC theory)" for design of OCB-mode LC cell. In addition, we invented a “Rubbing Shadow Domain method (RSD method)” to form the nucleus for an initial transition in OCB-mode LC cell. These fundamental theories result in a high performance CFS OCB-mode LCD with ultra low power consumption, wide viewing angle and high contrast ratio.

Novel-Structured and -Functional Nanocarbons Created by Nanoscopic Plasma Surface-Process Control

Rikizo Hatakeyama, Professor

Original approaches using nanoscopic plasma processes have been performed in order to develop C_{60}(Fullerene)- and SWNT(single-walled carbon nanotube)-based materials with new functions relating to nanoelectronics. Two kinds of macro-quantity synthesis methods for $N@C_{60}$ which encapsulates an atomic nitrogen inside the empty C_{60} are developed using electron-cyclotron resonance and double-magnetron discharge plasmas. Electron-spin resonance measurements indicate the largest value of over 0.01 % in the synthesis purity. Concerning the latter we have proposed a diffusion plasma-enhanced chemical vapor deposition method, by which individually-isolated and vertically-aligned SWNTs are successfully produced on a flat-surface substrate. In relation to the inner nanospace control of such pristine SWNTs, based on the formation of alkali-metals encapsulated SWNTs (A@SWNTs) using the substrate-bias method in alkali-metal plasmas, electronic transport measurements reveal that Cs@SWNT retains the air-stability with an n-type semiconducting property in contrast to the pristine-SWNT property while Li@SWNT exhibits ambipolar (p- and n-type) transport behavior. In addition we have started to perform experiments on the formation of ferromagnetic atoms encapsulated SWNTs using thermal and plasma combined-processes. Finally we have succeeded in the formation of DNA encapsulated SWNTs (DNA@SWNTs) using electrolyte micro plasmas in solution, where radio-frequency and direct-current electric fields are superimposed in order to stretch random-coiled DNA and transfer DNA negative ions toward pristine SWNTs.

Surface Infrared Study of DNA Attachment and Hybridization at Si Surfaces

Michio Niwano, Professor

In this study, we have in-situ investigated DNA immobilization and subsequent hybridization on Si surfaces using infrared absorption spectroscopy in the multiple internal reflection geometry (MIR-IRAS). We use the 3-aminopropyl-trethoxysilane (APTES) to functionalize Si surfaces with the amine group for DNA attachment. MIR-IRAS data, together with ab-initio cluster calculations, demonstrate that the amine-terminated surfaces are covalently coupled to thiol-modified oligonucleotides using a cross-linker (SSMCC). Hybridization experiments reveal that we can detect DNA hybridization through infrared spectral profiles in the frequency region around 1700 cm-1 where the vibrational modes of the bases appear. The present results show that MIR-IRAS is a powerful tool for the label-free detection of DNA hybridization as well as the in-situ (in-vitro) characterization of conformation changes of DNA molecules at Si surfaces in aqueous solutions. Furthermore, we suggest that since MIR-IRAS is intrinsically sensitive to surface vibrations, it can be applied to DNA sensors for the analysis of the gene expression and interactions between gene and proteins.

Reliable Congruent Composition of $LiTaO_3$ Single Crystals Determined by the Line-Focus-Beam Ultrasonic Material Characterization System

Junichi Kushibiki, Professor

The true congruent composition for $LiTaO_3$ single crystals was determined by measuring the velocities of leaky surface acoustic waves (LSAWs) with the line-focus-beam ultrasonic material characterization (LFB-UMC) system for two 42° *YX*-$LiTaO_3$ crystal ingots. The congruent composition determined was 48.460 Li_2O-mol%, corresponding to the LSAW velocity (42° *YX*-$LiTaO_3$) of 3125.3 m/s, and the absolute relationship between the LSAW velocity and chemical composition was obtained. Simulations on the variation of the melt and crystal compositions in a mass production of 40 crystals were conducted as a function of the composition of the starting material around the congruent composition. The result showed that the distributions of the melt and crystal compositions within and among the crystals varied largely with the material composition, providing the relationship of the material composition with the maximum composition variation for the 40 crystals. Based on these results, we verified the relationships between the tolerance of the material composition variation and the tolerances for the SH-type SAW velocity, LSAW velocity, and Curie temperature. The material composition needs to be constrained to within ±0.007 Li_2O-mol% around the congruent composition to mass-produce crystals with reliable homogeneity, satisfying the tolerance of ±0.01% in the SAW velocity.

Ferroelectric Data Storage with 10 Tbit/inch^2 Memory Density and Sub Nano-Second Domain Switching Time

Yasuo Cho, Professor

Nano-sized inverted domain dots in ferroelectric materials have potential application in ultrahigh-density rewritable data storage systems. Herein, a data storage system is presented based on scanning nonlinear dielectric microscopy and a thin film of ferroelectric single-crystal lithium tantalite. Through domain engineering, nano-sized inverted domain dots have been successfully formed at a data density above 10.1 Tbit/in.^{2} and sub- nanosecond (500psec) domain switching speed has been achieved. Moreover, actual information storage is demonstrated at a density of 1 Tbit/in.^{2}.

Nanometer-scale Characterization of Surface Materials by Scanning Tunneling Microscope (STM) Light Emission Spectroscopy

Yoichi Uehara, Professor

When electrons (holes) are injected from the tip of a STM to a sample surface for a tip-sample bias voltage of a few volts, visible light is emitted. Since the beam diameter of electrons from the STM tip is narrower than ~1 nm and moreover the beam energy is very low, one can obtain the light emission spectra of individual nanometer-scale structures without modifying them. By correlating the spectra with the size and shape of the structure, materials information about nanometer-scale individual structures can be obtained. Three recent applications of the STM light emission spectroscopy in nanometer-scale characterization of surface materials, vibrational spectroscopy of individual surface adsorbates, single molecule optical spectroscopy and localized surface plasmon (LSP) spectroscopy with pico-second time resolution, are reviewed in the present presentation. These applications demonstrate that the STM light emission spectroscopy is a unique tool for characterizing surface materials with atomic spatial, meV energy, and pico-second time resolution.

Linear System Theory from a Signal Processing Point of View

Masayuki Kawamata, Professor

This paper gives a new look at linear sate-space systems from a signal processing point of view. We first discuss the invariance property of second order modes of linear systems under frequency transformation and the complement property of the controllability grammian and the observability grammian of a pair of power complementary systems. Frequency transformation and power complementary concepts are well-known in the frequency domain of signal processing field. We next introduce their corresponding properties in the time domain using the state-space formulation, especially using the controllability and observability grammians and the second-order modes.

Face Recognition Architecture for Man-Machine Interactive System

Hirotomo Aso, Professor

User authentication is necessary for man-machine interactive system. Face recognition is a useful authentication method, since there is little load for users and it is effective for user identification. A face recognition architecture is proposed.

Advanced Multi-Modal Processings for Small Size Devices Used in New Generation Electronics

Shozo Makino, Professor

Speech and image are very important input/output media for small size devices such as PDA and a mobile phone used in new generation information electronics system. In order to develop a high-accuracy speech and image recognition and understanding system, in this year, we have carried out the researches concerning to the following five topics.1) A human and machine communication system using speech and image: We have developed a discrimination system among laugh, smile and normal based on speech and face recognition, 2) Robust speech recognition system for various kinds of speech: We have constructed a noise robust speech recognition system in which each distribution of each node in phoneme HMM represents a single kind of noise, 3) A portable spoken dialog system for a small task: We have refined on a Bunsetsu model and a generation model of utterance candidates, 4)CALL system for non-native speakers based on speech recognition: We have refined on a detection method of error-pronunciation, and 5) Music information retrieval system with query-by-song using error tolerant melody matching: As we have not used lyrics for music information retrieval yet, we introduced recognition of lyrics using speech recognition.

Compact, Multi-Functional Coherent Light Sources and Applications

Hiromasa Ito, Professor

Our research activities are aimed for the development of novel, compact coherent light sources with multi-functionalities, exploring new application fields. Frequency-agile terahertz (THz)–waves were successfully generated by using nonlinear optics and telecom devices. We have also developed a dual-wavelength optical parametric oscillator (OPO) with a Galvano scanner, which has a very wide and fast tunability. Applied to difference-frequency mixing in a $ZnGeP_2$ crystal, mid-infrared light (peak power: hundreds kilowatts) was generated in the wide wavelength range from 5 to 12 μm. Spectroscopic application of the high-power tunable mid-infrared source is also demonstrated. In order to explore the novel biophotonics (THz biosensing), coherent anti-Stokes Raman spectrometer has been developed by use of dual wavelengths from near-infrared OPO's. The spectrometer was successfully applied to the detection of THz vibrational modes in biomolecules in aqueous solution. The laser-oscillation mechanism and applications of a frequency shifted feedback (FSF) laser has also been under our investigation. The FSF laser has a unique feature of shifting its frequency with several-hundred petahertz per second, which was applied to the very accurate optical frequency-domain reflectometry, such as three-dimensional profilometry.

Specialty Fiber Optics for Laser Medicine, Optical Communications, and Industrial Applications

Yuji Matsuura, Associate Professor

Laser delivery system using hollow optical fibers

A hollow optical fiber is a thin glass tube with a diameter less than 1mm which has inner coating of metal and dielectrics. This fiber enables delivery of high-powered laser light with the wavelength region including infrared, visible, and ultraviolet. Our laboratory develops various kinds of hollow fibers and optics for medical, dental and industry applications.

Optical fiber devices utilizing photonic bandgap structure

We develop devices for optical communications using glass fiberoptics with a radial periodic structure. Optical devices giving various optical functions are fabricated by optimizing the design of the photonic bandgap structure.

Recent Activities for Ultrahigh-speed Optical Communication

Masataka Nakazawa, Professor

With the vast growth of traffic on the Internet from simple text data to high quality voice, images, and video, it has become increasingly important to realize a high-capacity and high-speed network to support the daily needs of modern communications. Ultrahigh-speed optical communication is the key technology for building such an interconnected world. We aim to achieve a global ultrahigh-speed optical network in the 21 century by engaging in the research of ultrashort pulse generation and transmission. In this poster we describe our recent activities for optical soliton transmission, ultrahigh–speed optical time division multiplexed (OTDM) transmission, high-speed lasers, and photonic crystal fibers with new applications.

Simultaneous EM Measurement System Using Parallelly Modulated Probe Array

Kunio Sawaya, Professor

A simultaneous measurement method using parallelly modulated probe array is proposed to measure the electromagnetic radiation. Each modulated probe is excited by a local signal with different frequency, so that the received IF signal contains different frequency components which indicate the relative magnitude of the RF signal at positions of the probes, and all the IF components are measured simultaneously by a broad-band micro wave receiver. The configuration of the measurement system is described. The performance of the system is demonstrated by the measurement time and some experimental results such as the radiation pattern and the radiation efficiency of measured antennas.

Gigabit Wireless Signal Processing and Networking

Fumiyuki Adachi, Professor

In the next generation wireless networks, very high-speed data services in the range of 100Mbps-1Gbps are demanded. There are two major obstacles for supporting such high data rate services; one is the frequency-selective fading and the other is the high transmit power problem. To overcome the two obstacles, advanced wireless technologies are necessary. Gigabit wireless signal processing and wireless network are the research areas of our interest. Research topics of gigabit wireless signal processing include frequency-domain equalization techniques for code division multi-access (CDMA), space-time coded transmit/receive diversity, multi-input multi-output (MIMO) antenna technique, hybrid automatic repeat request (ARQ), adaptive channel estimation, etc. In the area of wireless network, we are focusing on a wireless multihop virtual cellular network (VCN), which is different from the present cellular network. Research topics include wireless multihop, multihop route construction, dynamic resource (power, frequency) allocation, etc.

Transportation

Sendai Airport

Airport
Limousine
Bus
(30 minites)

Narita International Airport

Railway (JR East)
Ltd. Express “Narita Express”
(60 minites)

Tokyo Station

Railway (JR East)
Tohoku Shinkansen “Hayate” or “Yamabiko”
(2.0 hour)

Sendai Station

TAXI: 5 minutes

WALK: 15 minutes straight down “AOBA DORI”

BUS: 5 minutes
Take bus marked:
(No.9 bus stop)
“宮教大" (MIYAKYODAI)
"青葉台" (AOBADAI)
(No. 11 bus stop)
“緑ヶ丘三丁目” (MIDORIGAOKA)
(No. 12 bus stop)
“長町南駅・長町(営)” (NAGAMACHI-MINAMI)
Get off at "晩翠草堂前" (BANSUISODO MAE). It is the 2th stop.

Sendai Excel Hotel Tokyu