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New Senior Members

The following individuals were elevated to Senior Membership Grade thru Sept:

Kurt R. Lehman	Richard V. Penty	Mauro Varasi
Shayan Mookherjea	Slawomir Sujecki	

Chapter Highlights – Taipei Chapter

Ching-Fuh Lin, Professor, email: cflin@cc.ee.ntu.edu.tw

Despite the political controversy of whether Taiwan is an independent country or a part of China, Taiwan has invested heavily in the high technology industry. In 2007, Taiwan generated revenues of US$65 billion in optoelectronics and photonics, representing over 15% of the global photonics market. In contrast, Taiwan's population is only 0.35% of the global population.

There is good research and development support from Taiwan's National Sciences Council, Ministry of Education, Ministry of Economic Affairs, and cooperation between the universities and industry. With long-term government support, Institutes and Departments of Photonics or Optoelectronics in several universities and the Industrial Technology Research Institute (ITRI) have trained many excellent engineers and researchers. Currently about 230 professors and 2000 graduate students are involved in 274 projects in the photonics area supported by the National Sciences Council of Taiwan. Those graduate students will eventually mostly work in the photonics industry.

Optical societies (IEEE LEOS, OSA, SPIE, Photonics Industry and Technology Development Association, and Optical Engineering Society of the Republic of China) also play important roles in organizing conferences, workshops, and exhibitions in Taiwan. Each year Taiwan hosts the Optoelectronics and Photonics in Taiwan (OPT) conference for academic societies and the OPTO Taiwan exhibition for industry. OPT 2007 attracted about 1000 attendees, mostly professors and students. OPTO Taiwan 2008 had 264 Exhibitors, 660 Booths, and over 32,600 visitors, including 3600 people from other countries.

Membership Section (cont'd)

The momentum of photonics and optoelectronics in Taiwan is certainly not motivated by the IEEE LEOS Taipei Chapter alone. However, the Chapter here has set its goals to continue supporting photonics R&D and industry particularly via the facilitation of professional networking in the LEOS technical areas. We will continue to invite distinguished international experts to give lectures, encourage local researchers to communicate and cooperate with experts in various countries, and organize or co-sponsor conferences in photonics. In particular, because LEOS members here are mainly from universities, our focus is on the research activities of universities which are usually several years ahead of the industry. Here we would like to highlight the research activities of photonics and optoelectronics in National Taiwan University.

The Graduate Institute of Photonics and Optoelectronics (GIPO) at National Taiwan University was established in 1992. It has thirty-four full-time professors, one adjunct professor, and two distinguished chair professors, Chen-Shui Tsai and Tingye Li. GIPO annually admits about 100 master students and 30 Ph.D. students, and offers more than fifty graduate-level elective courses relevant to photonics. The goal of GIPO is to educate the next generation of leaders in the field of photonics and optoelectronics. More than 100 high-quality journal papers are published each year from GIPO.

With applications in energy saving/harvesting, new internet infrastructures, high quality displays, multimedia entertainment, and improved medical care, the development and application of photonics and optoelectronics technology have become increasingly important to society. Therefore, GIPO covers a broad research spectrum of the key photonic and optoelectronic technologies including: (1) Display technologies: liquid crystal displays (LCD), organic light-emitting diode (OLED) displays, poly-Si and amorphous thin film transistors, projector techniques, and optical MEMS for display applications; (2) Energy harvesting technologies: solid-state lighting, solar cells, wide-band-gap semiconductors, novel materials and nanostructures for light-emission; (3) Nanotechnologies: semiconductor quantum dots, photonic crystals, surface plasmonics, silicon-photonics and nm-scale diagnosis; (4) Nonlinear optics: nonlinear photonic crystals, wavelength conversion, and micro-structure optics; (5) Optical communication: active and passive fiber-based devices, modules and subsystems; (6) Bio-photonic technologies: bio-photonic sensing and instrumentation, optical coherence tomography, optical harmonic and THz imaging. Some highlights from these areas are summarized below

(1) Solid-state lighting devices

Prof. JianJang Huang is working on InGaN/GaN MQW nanorod LED structures. The relaxed strain in InGaN layers of these structures suppress the piezoelectric field resulting in lower blue shift of the EL at high current compared to

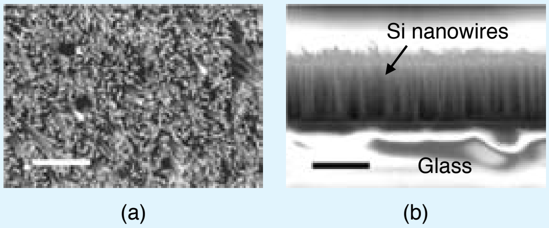

Figure 1 Scanning electron microscope (SEM) images of high-density Si nanowires transferred onto glass substrate: (a) top-view SEM image; (b) side-view SEM image. The SEM images show that the transferred Si nanowires are still vertically aligned. The X-ray diffraction investigation also confirms that the crystal orientation of Si nanowires is the same as the Si wafer. Scale bar: 5 μm.

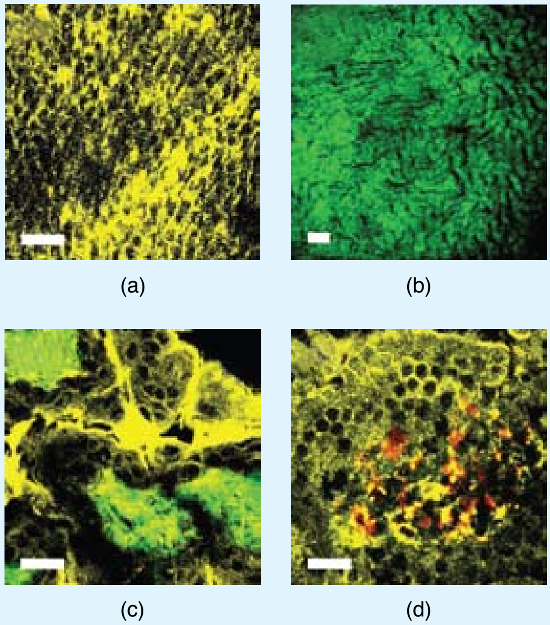

Figure 2 Backward-collected HGM images of (a) teeth enamel (b) corneal stroma (c) mice skin and (d) mice lymph node with staining. THG, SHG, and TPF are represented by yellow, green, and red pseudo-color, respectively. In (a) the enamel rod structures are revealed by THG. In (b) corneal stroma, the collagen fibers are revealed by SHG. In (c) THG and SHG show the cellular morphology in the epidermis and collage fibers in the dermis, respectively. In (d) addition to the cellular morphology revealed by THG, the staining cells are seen. Scale bar: 20μm.

conventional planar structures. Prof. Yun-Li Li is working on the well-known fundamental problem for InGaN/GaN multiple-quantum-well (MQW) LEDs, namely the efficiency "droop", which is the reduction in efficiency when electrical current is increased. InGaN/GaN-based MQW LEDs have been optimized with drastically reduced droop effect, to less than 5% at a current density of 200 A/cm^2.

(2) Solar cells

The foreseeable depletion of fossil fuel and the global warming caused by carbon dioxide emissions has led to increasing attention on alternative renewable energies, especially photovoltaics (PV). Therefore, crystalline Si-PV devices are quickly spreading. Unfortunately, the large consumption of Si materials hinders growth. Attention has turned to developing thin-film PV devices. Here Prof. Ching-Fuh Lin's group focuses on the use of nano-structured and micro-structured semiconductors for efficient and cheap thin-film solar cells. A technique of nanowire/micro-structure transfer has been developed for solar cells. In this approach, the nanowires and microstructures are made from bulk semiconductors or epitaxial semiconductors, so they will have much better crystal quality than the usual thin-film materials. They are then transferred onto glass or plastic substrates. After nanowires and microstructures are transferred, the original wafer can be reused, so the material cost can be lowered considerably. Several types of such thin-film solar cells are under investigation, including the organic-semiconductor-nanowire composite film, organic-semiconductor micro-structure composite film, nano-wire semiconductor thin film, and micro-structured semiconductor thin film. Such new-type thin-film solar cells are expected to be both efficient and low cost.

(3) Biophotonic sensing

Higher harmonic generation microscopy (HGM), including second harmonic generation (SHG) and third harmonic generation (THG), leaves no energy deposition and thus provides the "noninvasiveness" nature desired for clinical diagnosis. Higher harmonic generation microscopy provides excellent three-dimensional (3D) sectioning capability. By choosing an infrared laser working within the biological penetration window, HGM imaging with sub-micron 3D resolution and millimeter penetrability can be achieved in live specimens. THG, which is sensitive to the interface, can be used as a general-purposed tool to examine morphology of tissues. SHG can reveal the organized nanostructures such as collagen and neural fibers. For in vivo imaging of human and clinical diagnosis, the backward-collection type HGM has been developed and the imaging of fixed, fresh samples, in vivo animal models, and in vivo human skin based on a backward-collection geometry have been demonstrated with about 300 mm penetration depth. The backward-collection type HGM has been applied to various fixed tissues like liver, lung, eye, and cartilage, as well as the in vivo imaging of the animal models. For clinical applications, a bedside imaging system including an endoscope imaging system and a miniaturized laser source are now being developed. HGM endoscope can be used to perform painless optical virtual biopsy and for clinical usage, HGM endoscope can provide a good tool for clinical diagnosis. Prof. Chi-Kuang Sun's group recently constructed a miniaturized two-photon/second harmonic generation microscope system using a micro-electro-mechanical system (MEMS) mirror. By asynchronous scanning of the MEMS mirror, he achieved 24 Hz frame-rate with sub-micron spatial resolution. This system can be used for the study of fast biological phenomenon such as blood flow and neuronal activity. The polarization anisotropy of second harmonic generation (SHG) in polyhedral inclusion bodies (PIBs) of nuclear polyhedrosis viruses (NPV) can be used to image the 3D distribution of PIB crystal. This newly developed technique can be used for the study of viral pathology.

(4) Si nanophotonics

Porous Si, Si nanocrystals in Si-rich SiOx, and Si/insulator superlattices have previously been studied to improve the light-emitting efficiency from Si. However, their electroluminescence (EL) efficiency is poor. Unless the Si-rich SiOx film is thin enough to allow carrier transport, the fabrication of light-emitting devices is impractical since the SiOx between Si nanocrystals may lead to high barrier for injecting carriers. To overcome this bottleneck, Prof. Gong-Ru Lin reported a new localized synthesis and desorption method for generating pure Si pyramids on the Si substrate. Prof. Lin has developed a CO_2 laser based in-situ and localized rapid-thermal-annealing (RTA) process for the SiO_x film and studied the structural aspects, optical properties and the size/density of localized precipitated Si or metal nanodots embedded in the SiO_x film after CO_2-laser RTA. To study the carrier tunning/injecting/charging and surface-state characteristics of the Si nano p-n junction Prof. Gong-Ru Lin developed a self-aggregated metal encapsulated dry-etching process for the fabrication of Si nano-rod based MOSLEDs. Noble-metal based nano particles were deposited and self-aggregated on the Si wafer as nano masks. A buffered dielectric layer between the metal and Si surface was proposed to speed the self-aggregation procedure. The growth of Si-rich SiO_x film with Si nanocrystal leads to a nano-roughened surface that increases light extraction efficiency, and the carrier transport/tunneling mechanism between Si nanocrystals and Si nanopillar was enhanced. With this structure, colorful MOSLEDs with highest power up to 1 mW, external quantum efficiency >0.2%, optical intensity of 140 mW/cm_2, and power-current slope: 2 ± 0.8 mW/A were achieved.

Because of the page limitation, the excellent research from other universities in Taiwan cannot be included here. In brief, the LEOS Taipei Chapter and the universities in Taiwan are devoted to educating pioneer experts in advancing photonics and optoelectronics.