April 2005

UCF College of Optics and Photonics
CREOL & FPCE

HIGHLIGHTS

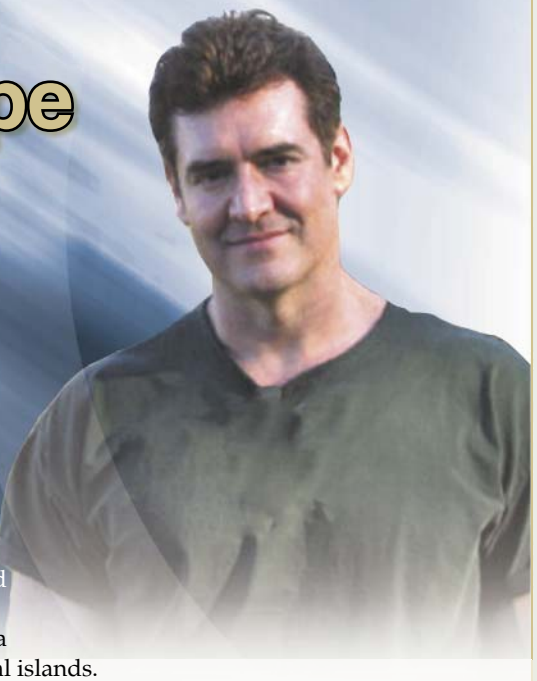
www.fpce.ucf.edu
www.creol.ucf.edu

INSIDE

"Creating the Future of Optics and Photonics"

Academics
❖
Research
❖
Partnerships

Dennis Deppe



The College of Optics and Photonics is pleased to announce that we will soon have another new faculty member. Professor Dennis Deppe, currently at the University of Texas at Austin, plans to join our faculty in September of this year, he will hold the FPCE Nanophotonics Chair. He will bring with him a research effort in semiconductor lasers. Professor Deppe's research is heavily based in the epitaxial growth of III-V heterostructures and how to apply these heterostructures to nanostructured active materials and nanophotonic cavities. For the last several years his research group has used molecular beam epitaxy to grow new types of nanostructured active materials based on a strained layer technique to form single crystal islands. These single crystal islands form what are commonly called quantum dots, which become the active emitters of laser diodes and spontaneous light emitters. The quantum dots are, in essence, artificial semiconductor atoms that exhibit discrete energy levels; and in many ways bring the best features of solid-state and fiber laser characteristics to semiconductor laser diodes. The semiconductor laser diodes, however, have a substantial advantage over other types of lasers in that they allow direct conversion of electrical current into light.

Professor Deppe originally comes from Illinois and attended the University of Illinois, where he obtained all three of his degrees in electrical engineering. In 1981

See **Deppe**, 3

Dean's Corner

Eric W. Van Stryland

My first Dean's Corner article was just after we had become the first college dedicated to optics in the nation. I've been getting lots of congratulatory messages from around the world. (I changed my photo just so I would look more "deanly".) Interestingly, I just saw an article in the Arizona Daily Star saying that the Optical Sciences Center at the University of Arizona in Tucson (where I was a graduate student a "couple" of years ago) just needs Board of Regents approval to become the second college in the country. We will certainly welcome them! One of the results of becoming a college is that we have considerably more influence on our local environment, including the important issue of fundraising by our Foundation. This is particularly timely since we have just chosen the architect and builder for the new CREOL building addition. We plan to build a three-story addition onto the north side of the building (phase 1), followed by another 3-story addition onto the west side. Given our desperate need for more lab and office space, and the space restrictions directly around our building, it is essential to maximize the square footage in each of the two addition phases. We have ~$3.6M for the phase 1 addition; but with skyrocketing building costs, it is clear that this is not sufficient. Even if we wait until later to build out the third floor, we are ~$750,000 short. The State of Florida has a very nice matching funds program that matches donated dollars one for one. That means if we can raise ~$375,000 from outside sources, we can build at least the shell for the third floor of the addition. We are just now initiating a capital campaign for which this will be one of the goals. Donors will be able to name the addition, labs, conference rooms, etc. Please contact me if you are interested! (Alumni – please note that every dollar helps. We can package donations together into a lump sum that will be matched, i.e. $1 "=" $2 – now that's good math!)

e-Highlights

We have started a new information resource called "e-Highlights" which Jim Pearson is putting together along with Courtney Lewis. It is e-mailed monthly to those who want more frequent updates (they are brief!). However, as we examined our contact database, we found that we do not have e-mail addresses for many of you who receive these quarterly printed Highlights. We sent out letters asking that you give us your full contact information. Please do respond to this request. You can also simply go to our website at http://www.creol.ucf.edu/people/associates/.

IA Day 2005

Please join us for our Industrial Affiliates Day on Friday, April 1 (at the end of the week of the Orlando SPIE Defense & Security Symposium). For full information on the program and registration, go to www.creol.ucf.edu and click on the Industrial Affiliates Day link. Also, please stay one more day for our annual picnic "The Spring Thing" at VP for Research MJ Soileau's house on Lake Jessup, where we'll watch and eat gators, along with a sumptuous variety of other fauna and flora…

CREOL Reunion

We recently hosted a CREOL reunion at Photonics West, with a great turn out. Jim Pearson and others made it, but I was working for the OSA in Australia!

CREOL & FPCE in the News

We continue to get good press in the professional magazines. The August issue of OPN (page 11) talks about the Florida Photonics Center of Excellence (FPCE) in "Centers of Excellence Fuel Research and Development". CREOL and FPCE were mentioned in Photonics Spectra December 2004 (page 49), regarding the $1.5M grant that the US Economic Development agency awarded for the CREOL expansion. See http://www.photonics.com/spectra/business/XQ/ASP/businessid.1196/QX/read.htm . Laser Focus World also discussed this. We hope to begin construction this summer.

New Faculty

I am very pleased to announce that Professor Dennis Deppe, currently at the University of Texas at Austin has accepted an FPCE Nanophotonics Endowed Professorship with us. The cover article in this issue provides more information on Dennis' accomplishments and interests. We are delighted that he will be joining us!

New Fellowships

I am also happy to announce that the NSF division of Graduate Education has just announced the award of $1,715,000 to the College of Optics and Photonics for a 3-year program offering fellowships to UCF graduate students. David Hagan is the PI. The program, titled "The Greater Orlando GK-12 Partnership" funds graduate students to work with teachers in Orange County Public Schools. The goal is to help improve content in the 9th grade integrated science curriculum. Part of the funds will be used to provide stipends for participating teachers.

Finally, on a personal note, I would like to thank SPIE and its members for electing me a Fellow of the Society. Another of our professors, Dr. Guifang Li was also elected as an SPIE Fellow.

Deppe, from cover

he obtained his Bachelor of Science in EE, and then went to work for Hewlett-Packard in Colorado working on high speed silicon integrated circuits. After two years at HP he returned to the University of Illinois where he obtained his M.S. in 1985 and Ph.D. in 1998 in electrical engineering. His thesis work centered on impurity diffusion and atom self-diffusion in III-V semiconductor heterostructures, which he used to fabricate new types of semiconductor layers. A novel feature of this process, called impurity-induced-intermixing, is the ability of impurity atoms to "intermix" thin heterostructure layers, and selectively convert the epitaxial layered structures to bulk semiconductor. The impurity-induced-intermixing is now used in high power laser diodes to eliminate the catastrophic failure that otherwise limits their maximum power.

After obtaining his Ph.D. from Illinois, Dr. Deppe went to work at AT&T Bell Laboratories in Murray Hill, New Jersey. There his research focused on two problems, understanding impurity diffusion effects in high speed heterojunction bipolar transistors and the development of a new type of semiconductor laser, the vertical-cavity surface-emitting laser or VCSEL. His work on bipolar transistors showed that the usual p-type impurities of the time, beryllium or zinc, could not lead to high performance because of impurity diffusion interactions between the base and emitter of the transistor. Because of these effects carbon is now used as the p-dopant in essentially all high speed bipolar transistors, with the most common application for such transistors being cell-phones.

In 1990 Professor Deppe joined the University of Texas at Austin where he continued his research in VCSELs. In particular he was interested in the electrodynamics in such small cavities, and also began work on microcavity light emitting diodes. In 1994 he and his research group introduced a new type of VCSEL that used a thin, oxidized aperture to confine both the optical mode and current injection. This new VCSEL, commonly called the oxide-confined VCSEL, now represents about 50% of the commercial VCSEL market for high speed short distance interconnects. Its main attributes are very low threshold current due to the optical mode confinement, which in turn produces the high speed needed for data transmission in excess of ~2 GB/sec. In 1996 his group also began research into a new growth technique that had been demonstrated to produce high quality epitaxial nanostructures, and quantum dot lasers. There are at present three key wavelengths for fiber optic interconnects, 0.85 μm for short distance, 1.3 μm for intermediate distance, and 1.55 μm for long distance data transmission. In 1998 Professor Deppe and his UT research group demonstrated the first 1.3 μm quantum dot lasers, creating an important milestone in the quantum dot laser technology. However the initial lasers had severe temperature sensitivity, in contrast to theoretical predictions. Then in 2002 he and his graduate students solved the temperature problem, using a new active material design that stabilized the hole charge in the quantum dots. The 1.3 μm quantum dot lasers using the stabilized hole charge are now the subject of research by most of the top laboratories in the US, Germany, Japan, and Russia. This is because they operate with higher temperature performance than existing commercial laser diodes and represent an enabling technology for low cost, high speed medium distance optical interconnects. One of the important applications for such devices will be fiber-to-the-home and business.

Currently, Deppe's research group is continuing to develop new types of VCSEL and quantum dot laser technology, and is also beginning work on photonic crystal lasers. These new technologies can be important for very low power, but high efficiency photonics and devices that operate in the quantum regime needed for quantum cryptography and quantum computing. In addition, the new VCSEL techniques allow scaling of 2-dimensional arrays; and could be important for very high power laser diodes that can operate at 100's of watts, with good beam characteristics and spectral control. These types of lasers are not only important for high efficiency pumping of solid-state and fiber laser devices, but also for direct laser applications in free space optical communications, as well as ladar and lidar. His group remains heavily involved in the epitaxial growth of nanostructures. In his move to UCF and the College of Optics and Photonics he will bring a state-of-the-art molecular beam epitaxial system that will be a key component in his group's research efforts. He looks forward to establishing a strong effort in the research and development of new semiconductor materials, fabrication techniques, and laser diode technologies. "Although I had heard of CREOL and its faculty for many years, I had the first opportunity to visit last year when I participated in the 2004 Affiliates Day. In that visit I was extremely impressed with both the faculty and the facilities for laser and photonics research. I was struck with a vision of what the match between CREOL's existing research groups, and an effort in the growth and fabrication of laser diodes, and especially nanostructures and small cavities, could produce in research and education in photonics. I'm looking forward to joining the College, and working to turn these prospects into reality."

> " Currently, Deppe's research group is continuing to develop new types of VCSEL and quantum dot laser technology"

Research Focus: An Abstract

Pinning effect on the phase separation dynamics of thin polymer-dispersed liquid crystals

Yi-Hsin Lin, Hongwen Ren, Yung-Hsun Wu, Xiao Liang and Shin-Tson Wu

In this paper, the surface pinning effects on the phase separation dynamics of polymer-dispersed liquid crystals (PDLCs) with thin cell gaps are demonstrated. Comparing various boundary conditions, the inner surfaces of the substrates with (Fig.1(a)) or without polyimide layers [but no rubbing](Fig. 1(b)) cannot provide enough anchoring force, so in either case the liquid crystal (LC) droplets flow and coalesce to form larger and less uniform droplets. However, if the inner surfaces of the substrates are coated with rubbed polyimide layers with anchoring energy >$1x10^{-4}$ J/m^2 (Figs. 1(c) and (d)), almost all the nucleated LC droplets grow at a fixed position during phase separation. The appearance of the coalescence is not obvious and the formed LC droplets are relatively uniform. The morphology in the homogeneous cell with a weaker anchoring energy ~$1x10^{-4}$ J/m^2 is also not uniform as shown in Fig. 1(e). The surface anchoring has a significant effect on the morphology of PDLCs.

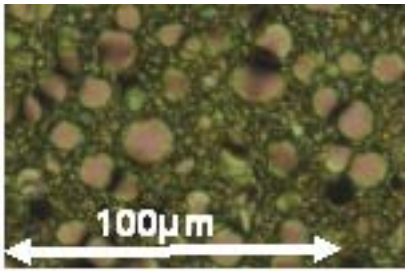


figure (a)

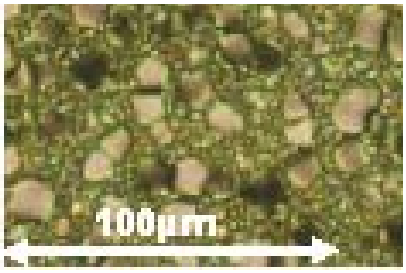


figure (b)

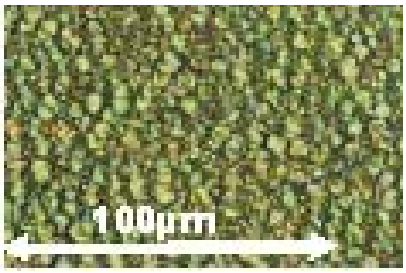


figure (c)

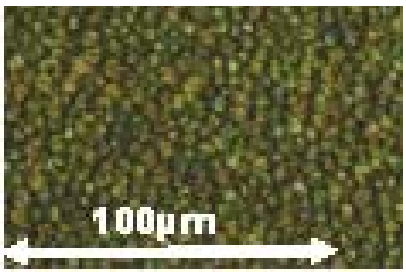


figure (d)

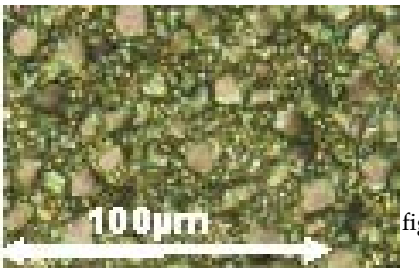


figure (e)

Fig. 1. Phase separation morphologies of PDLC in (a) conventional cell, (b) PI cell without rubbing, (c) TN cell (anchoring energy ~$3x10^{-4}$ J/m^2), (d) homogeneous cell (anchoring energy ~$3x10^{-4}$ J/m^2), and (e) homogeneous cell (anchoring energy ~$1x10^{-4}$ J/m^2) observed from a polarized optical microscope. LC/monomer mixture: 70 wt% E48 and 30 wt% NOA65. Both devices have the same cell gap d~8 µm.

Heidi Hockel: Research Engineer / E-Beam Lithography; MicroPhotonics Laboratory

Alumni Focus: Heidi Hockel, M.S. '03

How did you become interested in Optics?

" I first became interested in Optics as a college student studying Theater. I saw a research program where they were building a laser, and I thought that would be fun to try. Soon after, I changed my major to Physics and began building a four foot CO_2 laser. Upon completion of my masters at UCF, I decided to stay in this field for two reasons. One reason is to stay on the cutting edge of technology, and the other is to represent the under-represented sector of women in this field."

Why did you choose UCF?
"I decided to come to UCF because they have a very well known program. The climate encourages creativity and partnerships with leading industries. After growing up in the mid-west, the weather was also an enticing factor!"

What attracted you about the grad program in Optics at UCF?
The program is small yet very well respected, which made it attractive to me. Many of the professors are genuinely interested in your success.

Lasting impression…
"This training is invaluable to me, and will set me apart from others in my field. Where better to get experience than a university focused on research, with top-notch professors and industry initiatives, extremely advanced capabilities and equipment, not to mention the fact that it is located in the heart of the sunshine state."

Fall 2004 Graduates

Student	Advisor	Degree
Georgios Almpanis	Non-Thesis	MS
Te-Yuan Chung	Bass	Ph.D.
Cedric Lopez	K. Richardson	Ph.D.
Joachim Meier	Stegeman	Ph.D.
Waleed Mohammed	Johnson	Ph.D.
Bojan Resan	Delfyett	Ph.D.
Mohammed Sakami	Non-Thesis	MS
Chan Ching Tsai	Non-Thesis	MS
Erdem Ultanir	Stegeman	Ph.D.
Laurent Vaissie	Johnson	Ph.D.
Arnaud Zoubir	M. Richardson	Ph.D.

Reminder: Alumni and others who have been associated with CREOL can go to our website and update their contact information online - see Alumni and Associates.

Invitation...

Industrial Affiliates' Day 2005

Friday April 1, 2005
UCF Student Union and CREOL Building
(Right after SPIE Defense & Security Symposium)

- Invited Speakers
- Exhibits
- Posters, papers and research
- Tours of CREOL Labs

followed by. . .

"SPRING THING"

Saturday, April 2, 2005
@ Soggy Acres (MJ Soileau's Place)

- Food (Gator, etc. Cajun Style)
- Beverages (all types)
- Music, games, door prizes
- Alligator Watching

All are welcome! Please call to RSVP
407-823-6800

Distinguished Visitors: Pierre Meystre Visiting Lecturer Series

The College of Optics and Photonics proudly extends a sincere thank you to distinguished visiting lecturer, Dr. Pierre Meystre, Chair of Quantum Optics at the University of Arizona's Optical Sciences Center.

Earlier this year, Dr. Meystre presented three seminars entitled, "When Atoms Become Waves," "Nonlinear Atom Optics of Bosons and Fermions," "Nonlinear de Broglie Optics -- The Road to Molecules." Nearly 150 faculty and student from across campus attended.

The distinguished lecturer series was conceived in an effort to broaden the scope and depth of knowledge in fields that the College faculty does not specialize. These types of lectures will inevitably expand the educational experience.

Alumni Reunion @ Photonics West -- San Jose, CA

Faculty and Student News

Student News: The Order of Pegasus is the highest honor our university bestows on its students- see http://www.campuslife.sdes.ucf.edu/OOP/OOPHome.htm. **Brian Monacelli**, a graduate student working with Dr. Glenn Boreman, has been inducted into the Order of Pegasus for 2005.

A former student of Nabeel Riza, Sarun Sumriddetchkajorn, has been awarded the 2005 ICO-ICTP prize. The ICO is the International Commission for Optics, and ICTP is the Abdus Salam International Centre for Theoretical Physics.

Jason Eichenholz of Newport Spectra-Physics (left), Dr Shin-Tson Wu, Professor at UCF, Chien-Hui Wen award winner from UCF, Yi-Hsin Lin award winner from UCF, and Gary Spiegel, Vice President of Worldwide Sales Newport Spectra-Physics at the Newport Spectra-Physics reception at Photonics West in San Jose.

Yi-Hsin Lin and Chien-Hui "Vicky" Wen received Newport Research Excellence Awards at SPIE's International Symposium, Photonics West 2005 with papers "Pinning effect on the phase separation dynamics of thin polymer-dispersed liquid crystals" (see page 4 for an abstract of this article) and "Ultraviolet Stability of Liquid Crystal Alignment Layers & Mixtures" respectively. In addition, Yi-Hsin Lin's paper was selected by Optics Express (January 24, 2005 issue) as a feature article. Ms. Lin and Ms. Wen are graduate students in Professor Shin-Tson Wu's Liquid Crystal Displays research group.

Faculty News: The College made a big splash at the annual UCF Office of Research & Commercialization (ORC) Awards gathering, which was delayed almost a semester by hurricanes. **Eric Johnson** was recognized for his NSF career award. The FPCE was recognized with a new "Bricks and Mortar Award" for the $1.5M EDA grant (**Eric Van Stryland** brought home an engraved brick!). Eric also thanked MJ and Tom O'Neal for the hard work they put in on this proposal - as well as all of the Office of Research & Commercialization (ORC) and the EDC. The College got the largest single award of $10M for the FPCE, i.e. the "Big Spender" award. We also got the "Most $" award as part of the "Millionaires Club" for those bringing in external research funding of $1M or more in the last year. The "Lonesome Spouse" award went to **Maggie Boreman** whose husband, **Glenn**, wrote 25 proposals! And Glenn also got a "Millionaires Club" award, as did **Shin-Tson Wu** and **Craig Siders**. **Peter Delfyett** and **Eric Johnson** each got a $2M "Millionaires Club" award. **Eric Johnson** and **Glenn Boreman** both got "Two-Timer" awards (i.e. "Millionaires Club", 2 years in a row), and **Peter Delfyett** and **S.T. Wu** both got "Three-Timer" awards! By now you get the idea…This would not have happened without all of the hard work of students and staff, at the College of Optics and Photonics!

Kevin Belfield, Joint Appointee of the College of Optics and Photonics, has been appointed the Chair of the Chemistry Department by the Dean of the College of Arts and Sciences.

Eric Van Stryland, Dean of the College of Optics and Photonics and Director of CREOL, was named by *Florida Trend* magazine in the November 2004 as one of the " 174 Most Influential Floridians", one of only 5 from the academic community selected for this honor.

Emil Wolf gave a Keynote lecture at the Frontiers in Optics conference held in Rochester, NY Oct 10-14. In addition there was a special symposium entitled "50 Years of the Wolf Equations" at the meeting.

Upcoming Events...

- CLEO/QELS 2005
- OSA Annual Meeting
- SPIE Annual Meeting

See upcoming seminars at our site: www.creol.ucf.edu/about/events

Highlights is published by the College of Optics and Photonics, at the University of Central Florida.

The College of Optics and Photonics
CREOL & FPCE
P.O. Box 162700
Orlando, FL 32816-2700
www.creol.ucf.edu
407-823-6800

University of Central Florida

College of Optics and Photonics
CREOL & FPCE
PO Box 162700
Orlando, FL 32816-2700

Non-Profit Org.
U.S. Postage
PAID
Permit No. 3575
Orlando, FL

Address Service Requested

The College of Optics and Photonics: Industrial Affiliates

Welcome NEW Affiliates!

Life Members
Cobb Family Foundation
Dr. Arthur H. Guenther
Memoriam Member: Dr. William Schwartz
Northrop Grumman Corporation

Medallion Members
Agilent Technologies
JDS Uniphase
Northrop Grumman Laser Systems
Ocean Optics
Schott Glass Technologies
Paul G. Suchoski, Jr.
Tektronix

Senior Members
Analog Modules
Breault Research Organization
Brilliant Technologies Inc.
Essilor of America
H. N. Burns Engineering
Harris Corporation
Lambda Research Corporation
Lee Laser
Newport Corporation
Optical Research Associates
Optimax Systems
Optiwave Corporation
Zygo Corporation

Affiliate Members
A C Materials
Aerotech, Inc.
Coherent Technologies
Cubic Defense Applications Group
DRS Optronics
Fibertek, Inc.
Hewlett Packard Company
Laser Institute of America
LaserPath Technologies
New Focus
Ocean Design, Inc.
OSI LaserScan
Photonics Spectra
Rini Technologies
Scionix
Siskiyou Design Instruments
SPIE- The Int'l Society for Optical Engineering
Spiricon
Technical Manufacturing Corp.
Texas Instruments
Tower Optical Corporation
TwinStar Optics, Coatings & Crystals
Veeco Instruments

Is your company an Affiliate member? If not, it should be!

Join now to support the College of Optics and Photonics and enjoy the program's benefits.

Go to: www.creol.ucf.edu/people/affiliates
or call:

Jim Pearson	407-823-6858
Diana Randall	407-823-6834