FINAL PROGRAM

Fourth Annual Pacific Northwest Optics Workshop

May 4, 2019

Oregon Tech (Wilsonville Campus)

2019 Chair

Dr. Scott Prahl

Oregon Tech

27500 SW Parkway Drive

Wilsonville

The fourth annual Pacific Northwest Optics Workshop (PNOW) will be held at Oregon Institute of Technology (Wilsonville Campus) on May 4, 2019. This free workshop is supported by the Optical Society of America (OSA) Columbia Section with cooperation from the OSA Oregon State University, University of Oregon, and Pacific University student chapters.

9:00 AM
Robert Brown
Collins Aerospace
Waveguide Displays in Augmented Reality
Waveguide displays are becoming popular in augmented reality products because they are breaking the size and weight barriers that have prevented AR displays from being practical. But they have their limitations too. Rob Brown, a senior level optical engineer at Collins Aerospace, will discuss how waveguide displays work and how optical engineers are challenged to work with them.

9:20 AM
Andrew P. Carpenter and Geraldine L. Richmond
University of Oregon
Why so negative? Spectroscopic investigation into the accumulation of charge at nanoemulsion interfaces.
The addition of surfactants and polymers is the typical approach to stabilizing nanoemulsion systems, emulsions with diameters ~100's nm. However, in the absence of emulsifiers the neat aqueous-hydrophobic interface has been observed to acquire a significant negative charge, which in turn stabilizes these droplet dispersions. We have recently created nanoemulsions possessing negligible surface charge, calling into question whether the reported negative charge of neat hydrophobic surfaces is truly an inherent property of these interfaces. This talk will briefly

highlight the history of negative charge accumulation at hydrophobic droplet surfaces and present new insights into the surface structure and bonding environment of these low charge nanoemulsions through vibrational sum-frequency scattering spectroscopic (VSFSS) measurements. Ongoing work investigating the distortion of second-order spectral lineshapes, such as those measured using VSFSS, due to interfacial charge will also be presented within the context of understanding charge accumulation at neat aqueous-hydrophobic interfaces.

9:40 AM

Cameron W. Johnson, Benjamin J. McMorran
University of Oregon

High Efficiency Free Electron Diffractive Optics Made with Focused Ion Beam Gas-Assisted Etching

Free electrons accelerated to 80-300 keV form de Broglie matter waves with wavelengths 5 orders of magnitude smaller than optical wavelengths of electro-magnetic fields. Transmission electron microscopes exploit these small wavelengths to routinely resolve materials at the atomic scale. The emission sources in these instruments have reached the level coherence that allow the use of holographic phase masks to impart spatially varying phase profiles to the complex scalar electron waves. The difficulty is that the feature sizes of these holograms need to be as close to the limits of nanofabrication to be practical in applications. Here we present off-axis diffraction holograms in free standing Si3N4 membranes made using ion beam gas-assisted etching (FIB GAE) with binary, sinusoidal, and blazed groove profiles that exhibit near the maximum diffraction efficiencies. We show that FIB GAE has the nanofabrication properties required to create diffraction holograms able to arbitrarily shape the spatial phase of an electron wave for practical applications in electron microscopy, spectroscopy, and interferometry, and is also applicable for other mediums that form short wavelength complex waves such as X-rays, neutrons, and atoms.

10:00 AM

Jan Kleinert
ESI

Not all heat is created equal in silicon wafer laser scribing

The microelectronics packaging industy has widely adopted UV nanosecond laser scribing as the de-facto standard to remove the metal and interlayer dielectric layers (ILD) in die prep singulation, given the yield issues associated with mechanical dicing without laser scribing. However, with ever shrinking device thicknesses, particularly desirable in mobile applications, there is a need to further increase the die break strength (DBS) to optimize pick-and-place yields. As the heat affected zone (HAZ) due to the laser process is a key driver of reduced DBS a switch from nanosecond lasers to ultrafast lasers has become necessary. While it may not be particularly surprising that an ultrafast laser based process can achieve a smaller HAZ and correspondingly higher DBS, there are a few subtleties that need to be considered. Finally, it turns out that not all residual heat is necessarily detrimental: we report on a curious high throughput process that optimizes DBS and reduces debris through careful heat management rather than simple heat minimization.

10:20 COFFEE BREAK

10:40 AM

C. E. Fairchild, G. Baker*, S. Webb*, B. Baker*, and T. Baker*
Oregon State University, *CO2 Solved LLC

Use of a TiO2 Nanoparticle Treatment to Inhibit Foliar Chloroplast Strong-Light Avoidance Movement, as Measured Optically

Foliar chloroplast strong-light avoidance movement (FCPSLAM) in terrestrial plants is well known and understood. In strong overhead sunlight, foliar chloroplasts are piled up at vertical cell walls, in order to avoid photodamage. Nature has overcompensated. Recent work has shown that inhibition of FCPSLAM gives rise to increased photosynthesis and, therefore, an increase in plant growth. We have developed a new method for inhibition of FCPSLAM in which the plant leaves are treated with TiO2 nanoparticles. FCPSLAM and its inhibition are measured using a 405nm 10mW diode laser. The laser serves both as a strong light source and as a diagnostic tool. During the FCPSLAM process in a given plant leaf, the leaf becomes more transparent. Leaf transparency is measured by measuring the transmission of the 405nm laser light through the leaf. The 405nm wavelength was chosen because it is known that FCPSLAM is induced by blue light. In addition, TiO2 nanocrystals absorb strongly at 405nm; and their absorbed energy is typically dissipated via photocatalysis. The 10mW laser power is convenient for replication of the intensity of overhead sunlight at 405nm. Details of the lab work to optimize the TiO2 treatment process will be described; and photos of field trial work will be presented.

11:00 AM

Scott Prahl
Oregon Tech

August Beer and his terrible theory

Beer's law, or the Beer–Lambert law, or the Beer–Lambert–Bouguer law describes the attenuation of light in an absorbing medium. Specifically, the law states that the absorption coefficient is proportional to the concentration of the absorber and is named after August Beer. This talk reviews his 1852 paper and the elucidates the details of his pre-photodetector technique for quantitative measurements of light transmission. Beer used a visual photometer to balance light passing and not passing through a sample. Rotating Nicol prisms allowed him to attenuate light quantitatively using Malus's law. Oddly, Beer's theoretical analysis of his optical system turns out to be wrong in almost every detail; it also fails to provide the equation that bears his name. Nevertheless the results improve when the raw data is re-analyzed. For example, when using copper sulfate solutions, the relative error for two concentrations and two distances drops from 4% to 3%. Thus, despite the lack of an explicit statement that attenuation is proportional to concentration, and terrible data analysis, Beer provides convincing experimental evidence of this fundamental law of attenuation.

11:20 AM

Eric Udd and Ingrid Scheel
Columbia Gorge Research

Forty Years of Fiber Optic Gyro History in 15 Minutes

The first hardware demonstrations of fiber gyros occurred in the late 1970s. Now over 40 years later over 500,000 have been produced supporting a wide range of aircraft, rocket guidance, space missions to the moon and Mars as well as terrestrial navigation and tracking. This paper will provide an overview of where this technology has been, where it is now and where it is going.

11:40 AM

Josh Ziegler

University of Oregon

Deterministic Quantum Emitter Formation in Hexagonal Boron Nitride via Controlled Edge Creation

Quantum emitters (QEs) in 2D hexagonal boron nitride (hBN) are extremely bright and are stable at high temperature and under harsh chemical conditions. Because they reside within an atomically thin 2D material, these QEs have a unique potential to couple strongly to hybrid optoelectromechanical and quantum devices. However, this potential for coupling has been underexplored because of challenges in nanofabrication and patterning of hBN QEs. Motivated by recent studies showing that QEs in hBN tend to form at edges, we use a focused ion beam (FIB) to mill an array of patterned holes into hBN. Using optical confocal microscopy, we find arrays of bright, localized photoluminescence that match the geometry of the patterned holes. Furthermore, second-order photon correlation measurements on these bright spots reveal that they contain single and multiple QEs. By optimizing the FIB parameters, we create patterned single QEs with a yield of 31%, a value close to Poissonian limit. Using atomic force microscopy to study the morphology near emission sites, we find that single QE yield is highest with smoothly milled holes on unwrinkled hBN. This technique dramatically broadens the utility and convenience of hBN QEs and achieves a vital step toward the facile integration of the QEs into large-scale photonic, plasmonic, nanomechanical, or optoelectronic devices.