Third Pacific Northwest OSA Optics Workshop
Pacific University

Conference Room JEF 224

Saturday May 5, 2108

Hosts and Chairs: Karl Citek and James Butler, Pacific University

Workshop Committee: Mayra Amezcua, University of Oregon; Bryan Bolt, President OSA Columbia Section; James Butler, Pacific University; Karl Citek, Pacific University; Douglas Holmgren, Vice President OSA Columbia Section; Tom Plant, Oregon State University; Ingrid Udd Scheel, Secretary OSA Columbia Section; Eric Udd, Columbia Gorge Research LLC; and Alan Wang, Oregon State University

Welcome

9:00-9:05 Hosts Karl Citek and James Butler
9:05-9:20 Opening Remarks from Dean of Pacific University

Session 1: Chairs Karl Citek and James Butler, Pacific University

9:20-9:40 Low-Cost Picosecond Diode Laser Pulsers
Thomas K. Plant, PhD and Robert W. McMahon, NANO PULSERS LLC, Philomath, Oregon

Low-cost ps and ns diode laser systems are widely useful for applications in lidar, photodetector testing, and medical phototherapy among many others. Nano Pulsers LLC has developed simple, low-cost drivers which can be coupled with very low-cost mW-level CW diode lasers to drive them with ps or ns pulses at rates up to 2 MHz at peak outputs of many watts without degradation. The history of fast diode laser drivers will be reviewed considering factors limiting performance. A working visible ns laser will be demonstrated (Hardware Session 1).

9:40-10:00 Phononic Crystal Based Spin-Mechanical Systems in Diamond
Ignas Lekavicius, Thein Oo, Mark Kuzyk and Hailin Wang (PI), University of Oregon

We report on the design and fabrication of GHz diamond mechanical resonators embedded in a two-dimensional phononic crystal lattice that features a bandgap centered around 1 GHz with a gap size of 300 MHz. The phononic bandgap isolates and protects the mechanical resonator from the clamping loss. The GHz mechanical mode couples to color centers, such as nitrogen vacancy centers and silicon vacancy centers, implanted in the diamond mechanical resonator in the resolved sideband regime. Experimental results on spin-mechanical interactions through the excited-state strain coupling will also be discussed.

10:00-10:20 Investigation of Polymer Filled Capillary Waveguides for Self-Healing Systems
Derek Thomson, Pacific University

Self-healing systems have become popular due to an interest in reducing maintenance costs, increasing the lifespan of materials, and protect against damaging mechanisms. This project represents a budding collaboration between motorcycle apparel industry and academic partners. Therefore, emphasis is on the development of fibers with the ability to self-heal as they abrade, which would be transformational in the area of protective fabrics. A three-component photo-initiator and polymer will be added to the core of PFA TeflonTM capillary waveguides (CWS) then matched with a luminescent material. The luminescent material will act as a light source, for which the capillary waveguide will capture and propagate it through the unpolymerized monomer with the hopes of initiating polymerization. Surface modification was performed on the CWS to attach glycidyl methacrylate (GMA) to allow for monomer to adhere. The results are inconclusive as the GMA apparently polymerized throughout the fiber, which may hinder monomer-GMA bonding. Currently, an apparatus is being built to video record the high-speed abrasion of single fibers in real time. This will allow a comparison of the abrasion processes of the proposed self-healing fibers to those made of traditional materials.

10:20-10:40 Impact Testing Using High Speed Fiber Grating Sensor Systems
Ingrid Udd Scheel and Eric Udd, Columbia Gorge Research LLC

Columbia Gorge Research LLC has been developing a series of high speed fiber grating systems for characterization of energetic material. This presentation overviews usage of this system to monitor high speed impacts and fragmentation events. (Examples of hardware and applications with be displayed at Hardware Presentation I.)

10:40-11:20 Hardware Presentation I and Break

Morning Speakers are invited to display and talk about hardware. Demonstration of Nano Pulsers LLC ns laser and Columbia Gorge Research LLC high speed fiber grating items are included in this session

Session 2: Chairs Mayra Azemcua, University of Oregon and Ingrid Udd Scheel, Columbia Gorge Research LLC

11:20-11:40 Frequency Entanglement Swapping
Sofiane Merkouche and Brian Smith (PI), University of Oregon

Entanglement is one of the most distinguishing features of multi-partite quantum systems and, appropriately, a crucial resource in quantum information science. An important technique to aid in harnessing this resource is entanglement swapping, which enables entanglement of distant quantum systems and thereby the long-range distribution of quantum correlations, in addition to shedding light on the fundamental nature and extent of quantum non-locality. Here we demonstrate for the first time photon entanglement swapping in the frequency domain, a degree of freedom well-suited to current integrated optics technology. We verify entanglement in the swapped state using two-photon interference.

11:40-12:00 Optical Pyrometry in the Semiconductor Industry
Bruce Adams, Applied Materials, Rapid Thermal Processing Division

Temperature measurement by optical pyrometry is a key enabler in the manufacturing of semiconductors. The basic physics of pyrometry will be reviewed. Unique challenges in the fabrication of semiconductors include limited access, background radiation, variable wafer emissivity and the need for wide dynamic measurement range. Examples of how modern pyrometers solve these challenges will be presented.

12:00-1:30 PM Lunch Break
1:30-2:40 Pacific University Lab Tour

Session 3: Chairs: Tom Plant, Oregon State University and Eric Udd, Columbia Gorge Research LLC

2:40-3:00 Comparison of corneal astigmatism with manifest refractive astigmatism in pseudophakic eyes.
Omkar Thaware, B. Optometry, Maolong Tang, PhD & David Huang, MD, PhD, Research coordinator – COOL lab, Casey eye institute

3:00-3:20 Ultra-Sensitive Fluorescent Imaging-Biosensing using Biological Photonic Crystals
Kenneth Squire, Xianming Kong, Paul LeDuff, Gregory Rorrer, and Alan Wang, Oregon State University

Diatoms are a unicellular organism with a nanoporous biosilica shell called a frustule. These frustules represent a naturally occurring photonic crystal. Utilizing the photonic properties of these frustules, we create a diatom-based biosensor paired with fluorescence imaging. Using this sensor, we achieve a limit of detection of 10-15 M, a 10× enhancement when compared to a non-diatom based sensor. This natural photonic crystal-based sensor shows great promise for point-of-care fluorescence imaging.

3:20-3:40 A room temperature, graphene nanomechanical bolometer
Andrew Blaikie, David Miller, Max Kant, and Benjamín Alemán (PI), University of Oregon

Graphene based room and high temperature bolometers are attractive due to their ultra-broadband spectral absorbance and the stable thermal properties of graphene. However, sensitive electronic detection of temperature changes usually requires cryogenically cooling the graphene, limiting the potential applications of graphene bolometers. We report on the fabrication and characterization of suspended graphene nanomechanical bolometers which use a mechanical resonance-based temperature detection method. These devices reach a sensitivity of 500 pW/Hz 1/2 with a 3dB bandwidth of 24 kHz. This work demonstrates the potential of suspended graphene for ultra-broadband, room-temperature bolometry.

3:40-4:00 Laser machining of microelectronics components
Nicolas Falletto, PhD – Application Manager at ESI

We will briefly introduce the concepts of laser ablation and then describe how ESI is applying its laser matter interaction experience to solving customer via drilling problems in HDI and Flex markets

4:00-4:20 Single-Photon Emitters in Boron Nitride Nanococoons
Josh Ziegler and Benjamín Alemán (PI)

Single-photon emitters in 2D hexagonal boron nitride (hBN) exhibit promise for a broad range of quantum information applications with bright fluorescence and room-temperature stability. However, they are susceptible to strain – causing unwanted wavelength shifts. Using a combination of confocal and electron microscopy, we find a bright single-photon emitter in boron nitride nano-cocoons (BNNC) - a boron nitride nano-allotrope that overcomes strain susceptibility through structural robustness. We optically characterize our quantum emitters and find extensive similarities to the single photon emitters found in other hBN allotropes. Crucially, we find the emission wavelength of these single photon emitters varies a factor of five less than those in 2D hBN. This range is more similar to single-photon emitters in bulk hBN, corroborating our idea of structural robustness. This robust nano-allotrope of BN offers an ideal host of single-photon emitters for use in hybrid photonic technologies, quantum information, or biological labelling and sensing.

4:20-4:40 Standoff isotopic detection using laser induced fluorescence of laser-produced plasmas
S. S. Harilal, and M. C. Phillips, Pacific Northwest National Laboratory, Richland, Washington

Standoff rapid detection with no sample preparation is one of the most desired capabilities for radioactive nuclear materials. Currently, isotopic measurements are being performed in laboratory settings using mass-spectrometry based tools which is time consuming and not fieldable. Analysis of atoms, ions and molecules in the laser-produced plasma using optical spectroscopy tools provides isotopic information with the advantages of real-time analysis and standoff capability without requiring sample preparation. Both emission and absorption spectroscopy methods can be used for isotopic analysis of solid materials, however, applying optical spectroscopy to the measurement of isotope ratios from solid materials presents numerous challenges. The small proportional nuclear mass differences between nuclei of different isotopes leads to correspondingly small differences in optical transition energies. Along with this, various line broadening mechanisms in laser-produced plasmas, and instrumental broadening generated by the detection system, are technical challenges frequently encountered with emission-based optical diagnostics. These challenges can be overcome by using the techniques of laser-based absorption/fluorescence spectroscopy. In this talk, recent advancements in standoff isotopic detection from solid materials using optical spectroscopic tools in conjunction with laser-produced plasma will be discussed.

4:40-5:20 PM Hardware Presentation II and Networking

All participants are invited to “show and tell” hardware related to their work. Columbia Gorge Research LLC will display its collection of fiber optic gyro hardware as well as fiber optic smart structure artifacts.