JILA Workshop on
Biosensors Based on SPR Interferometry

JILA Room 10B
University of Colorado
Boulder, Colorado
April 18, 2006

Organizers:
Professor John Hall, JILA

Workshop Coordinator: Erik Kreider, AlphaSniffer (erik@alphasniffer.com) 303 545 5550

Lunch will be served.

Program

Presenting Attendees:
Professor John Hall, JILA, Boulder, Colorado, USA
Professor Aaron Ho, Chinese University of Hong Kong, Hong Kong, China
Dr. Bob Jones, Cambridge Consultants, Cambridge, United Kingdom
Professor Andrei Kabashin, École Polytechnique de Montréal, Montreal, Canada
Professor Petr Nikitin, Institute of General Physics, Russian Academy of Sciences, Moscow, Russia
Dr. Misha Plam, AlphaSniffer, LLC, Boulder, Colorado, USA
The AlphaSniffer Team: Slava Petropavlovskikh, Oyvind Nilsen, Bilge Hacioglu, Erik Kreider

8:30 – 8:45	Introduction and Welcome *Professor John Hall*
8:45 – 10:00	"SPR Interferometry: phase properties and biosensing applications" *Professor Petr Nikitin*
10:00 – 10:15	Break
10:15 – 11:30	"Surface plasmon resonance biosensor arrays based interferometric imaging" *Professor Aaron Ho*
11:30 – 12:30	Lunch
12:30 – 13:45	"The design and application of a monolithic SPR interferometer for array based measurement" *Dr. Bob Jones*
13:45 – 15:00	(insert title) *Professor Andrei Kabashin*

15:00 – 15:15	Break
15:15 – 16:30	"(insert title)" *Dr. Misha Plam*
16:30 – 17:00	Concluding Remarks *Professor John Hall*

Audience Attendees

Prof. Tom Perkins, JILA
Prof. Marv Caruthers and Mike Stowell, Biochemistry.
Prof. Kathy Rowland and John Birks, Chemistry
Prof. Kristi Anseth, Chris Bowman, Steven George, Richard Noble, Alan Weimer, Chemical Engineering
Prof. Donald Stedman, DU
and several scientist from AlphaSniffer, LLC

Presenter's Professional Information and Experience

Dr. John "Jan" Hall

Dr. Hall received the Nobel Prize in Physics in 2005 for his contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique, in addition to numerous other physics awards. He is currently a JILA fellow, Lecturer for CU and Senior Scientist at NIST. He has published over 240 papers and holds six patents. Dr. Hall received his PhD from Carnegie Institute of Technology in 1961.

Dr. Aaron Ho

Dr. Ho is currently an Associate Professor at the Department of Electronic Engineering of The Chinese University of Hong Kong (CUHK). As a photonics engineer and a material scientist, his research interests focus on novel applications of new materials or photonic technologies. Photonic biosensor based on the surface plasmon resonance (SPR) effect is one of those topics. He has been an invited speaker for his SPR biosensor work at LEOS Annual Meeting 2005. He also runs the metal-organic vapor phase epitaxy (MOVPE) facility in CUHK for preparing zinc oxide and related materials for blue LED applications.

Dr. Ho received his B.Eng and Ph.D. in Electrical and Electronic Engineering from University of Nottingham, U.K. (1983-90). His thesis was on the interdiffusion of semiconductor multi-quantum well structures. In 1990-94 he was a post-doctoral research fellow working on the growth and characterization of Co/Cu magnetic superlattices and laser interferometers for the detection of ultrasound surface waves. In 1994, he joined the Fiber Optic Components Operation of Hewlett-Packard (later known as Agilent Technologies) as a senior process engineer responsible for MOCVD growth of InGaAsP and optoelectronic device fabrication. He was then an assistant professor at City

University of Hong Kong (1996-2002). He is the current Chairman of the IEEE Hong Kong Chapter for Electron Devices and Solid-State Circuits. He has published over 130 conference and journal papers.

Dr. Robert Jones

Dr. Robert Jones is a Consultant with over thirty years professional experience in optical physics, system design and engineering. He has worked for Cambridge Consultants for the past twenty-three years. During this period Dr. Jones has developed a wide range of new optical systems. The latter include innovative designs of interferometer, spectrometer, optical sensor, precision laser machining system and micro-machined optical interface for which he has been granted nine patents. Specific projects for which he has been responsible include the development of:

- sub-micron precision, non-contact, surface form and finish laser gauges
- CO_2 laser systems for high speed, wide web hole cutting and marking
- low cost, monolithic Fourier Transform and dispersive imaging spectrometers
- optical fibre sensors for in-situ aero-engine diagnostics
- a high throughput, multi-wavelength confocal fluorescent microscope for cell diagnostics
- a fibre optic sensor array for the dynamic evaluation of rail-track fastenings
- in-line sensors for particle sizing and biological identification
- a multi-beam laser micro-machining system for IR detector array fabrication
- an interferometric surface plasmon resonance imaging system for non-labelled biological binding detection

Dr. Jones has also undertaken the analysis of new systems, technologies and emerging markets for a range of major companies that include Philips, Zeiss, Bundesdruckerei GmbH, Pharmacia Biotech, Conoco, B N F L and Beiersdorf GmbH.

He graduated from the University of Leeds with a BSc (Hons) degree in Physics and in 1972 was awarded a PhD from the University of Bradford for his work on the fundamental theory and application of holographic interferometry. In the following years, prior to joining CCL, he undertook a combination of post-doctoral research and consultancy at the University of Loughborough and established an international reputation for his work in holographic, speckle pattern and interferometric measurement techniques. This culminated in 1982 with the publication by the Cambridge University Press of the text book Holographic and Speckle Interferometry now in second edition in the Cambridge Series in Modern Optics.

During his career he has contributed to a number of international conferences and published a wide range of academic and general articles on interferometry, metrology, holography and optical sensing techniques.

Dr. Andrei Kabashin
Department of Engineering Physics
École Polytechnique de Montréal

Dr. Kabashin received his PhD in Physics and Mathematics with specialization in laser optics in 1994 from the General Physics Institute of Russian Academy of Sciences. His Doctoral thesis was "Laser-plasma generation of electric, magnetic fields and currents;" under supervision of Dr. Nikitin. He is currently research assistant professor at École Polytechnique de Montréal with specific interests in SPR applications in biophotonics for biosensors, nanophotonics and laser-matter interactions in nanoscale structures. Dr. Kabashin has published over 70 papers, 40 of which were in refereed journals, 1 book chapter and 4 patents and invention disclosures. Major scientific contributions include introduction of Si-based SPR geared toward miniaturization and integration of SPR biosensors, novel laser ablation-based methods for synthesis of functionalized non-toxic colloidal nanoparticles for use in biological systems, development of novel laser-assisted methods for nanofabrication in gases, and study of electromagnetic phenomena in laser plasma. He has also received funding for numerous projects from the Natural Sciences and Engineering Research Council of Canada, among others.

Dr. Petr Nikitin

Dr. Petr Nikitin received his Master's degree with Honors and a Ph.D. degree (Supervisor: Nobel Prize winner, academician A.M. Prokhorov) from Moscow Institute of Physics and Technology in 1979 and 1983, respectively. Author of more than 190 papers published in highly-rated pre-reviewed journals and more than 160 papers published in conference proceedings, he is also the inventor of 13 patents. His scientific carrier started in the renowned General Physics Institute of Academy of Sciences of Russia rapidly progressed from the research scientist (1983) to the Head of a large Laboratory (1989). In 2001-2004, while working at Advanced Laser Technologies and Innovation Research Center (Shrewsbury, MA), he was the Principal Investigator of several DoD projects.

Dr. Nikitin developed bio- and chemical sensors based on SPR interferometry and SPR-based optoelectronic Schottky structures, new spectral phase methods for bio-sensing, biosensors based on detection of magnetic nanoparticles. He also discovered new fundamental phenomena such as the reversible interaction of pure gold films with electroactive gases called ferromagnetic liquid nano-droplets. He developed several pioneering optoelectronic and fiber-optical sensor systems for detection of magnetic field and electric current applied to measure thrust and small displacements.

Dr. Nikitin was awarded Kapitza Fellowship from the Royal Society of the UK (1995) and the prize for one of four best papers at the 5th International Meeting on Chemical Sensors (Rome, 11-14 July, 1994). He was awarded and successfully directed multi-year research projects supported by European Commission, INTAS, International Science and Technology Center, by the Royal Society of Great Britain, Swiss National Science Foundation, and the Russian Foundation of Basic Research. He had successful collaboration with many research groups, including those in the UK (University of Kent, Canterbury and University of Wales, Cardiff), France (Universite de Franche-Compte, Besancon, Ecole Centrale de Lyon), Germany (Technical University of Dresden), Italy (University of Lecce), Switzerland (EPFL, Lausanne), etc.

He is a member of International Advisory Committees of two major sensor conferences: European Conference on Optical Chemical Sensors and Biosensors, and the Conference on Magnetic Sensors and Actuators.

Dr. Misha Plam

Misha Plam is the Founder, President/CEO and Chairman of the Board of AlphaSniffer, LLC. He is an expert on commercializing research and building high tech entrepreneurial companies. He founded Sievers Instruments, Inc., in 1984 and served as its Chairman, President, and CEO. The company received a number of SBIR awards and develops chemical analysis instruments for scientific and commercial purposes. One such instrument measured the quality of recycled water on the Russian Space Station "MIR" and is presently being used on International Space Station (ISS).

In 1997 Plam was selected as Ernst and Young Entrepreneur-of-the-Year (Rocky Mountain Region), and the same year was awarded Entrepreneur of Distinction at Esprit 97 in Boulder, Colorado. In 2000 Plam was elected as an Academician, one of only 77 foreign members in the prestigious Russian Academy of Engineering based in Moscow. He has been widely recognized for his contributions to the American-Russian Space Program and the SBIR program in the USA. In 2002 he was selected as a Fulbright Scholar to teach entrepreneurship in Russia.

After receiving his advanced degrees from Moscow State University with a focus on glaciology, Plam became director of the Mountain Research Station in the Caucasus Mountains of Russia. He immigrated to the United States in 1977 and became Director of Mountain Research Station and Adjunct Associate Professor of Civil and Environmental Engineering at the University of Colorado-Boulder.

Plam left in 1980 to work as Manufacturing, Service and Research Engineer, then Marketing Analyst at Pure-Cycle in Boulder. He helped found several companies in Boulder, then founded Sievers Instruments, Inc., in 1984. The company was sold for $21 million in 1996 to Ionics, Inc. After its sale, Dr. Plam continues to manage the company and stayed on as President through 2001 and as Chairman of the Board of Directors until 2003.

In 2002 he was asked by the Russian government and World Bank to introduce a SBIR program in Russia, where he delivered several presentations. Dr. Plam also co-authored a paper with Roland Tibbetts, "Roadmap for Russian SBIR Program," which will be published in 2004 (proceedings of Third Russian Venture Capital Conference, 2002).The proposed American SBIR program was adopted by the Russian Government under the name "START".

In June of 2004 Dr. Plam went to China with Government delegation led by Donald D. Evans, US Secretary of Commerce, where he successfully promoted US SBIR program for implementation in China.

Plam is now Limited Partner at Boulder Ventures, LLP, a venture capital firm, with more than $250 million under management and Entrepreneur- in- Residence in Boulder Quantum Ventures, LLC.

He has lectured on engineering and entrepreneurship at the University of Colorado, Stanford, and Plehanov Business Academy in Moscow, Russia and numerous research institutes in Russia. He's a member of the Advisory Board of the Center for Entrepreneurship at the University of Colorado and US Russia Center for Entrepreneurship.

He is married to Olga Plam, a well-known, successful still-life artist.