2 Applied Physics

Thursday, 3. Sept. 2009, Room G

Time	ID	Applied Physics I: Medical Physics *Chair: I. Furno, EPFL*
09:00		***PLENARY SESSION***
12:40		***Postersession, Lunchbuffet***
14:30	201	**SLM Microscopy** *Christian Maurer, Stephanie Fassl, Maxemilian Pitzek, Ruth Steiger, Stefan Bernet, Monika Ritsch-Marte* *Sektion für biomedizinische Physik, Müllerstraße 44, 6020 Innsbruck, Austria* A spatial light modulator (SLM) is a flexible diffractive optical element. The individual pixels of below 10µm pixel size can shift the phase of an incoming light source between 0 and 2ϖ. This allows the programming of high efficient Fourier filters, to visualize different structures of phase object, or to shift the phase of only a part of the light pattern with respect to the remaining wave, to get a common path interferometer for quantitative measurements of the optical thickness of phase objects. SLMs can also be used to change the spatial coherence of the illumination light, to get either a coherent light source for high accuracy measurements or to switch to an incoherent illumination to enhance the resolution. Different applications will be presented to shown the flexibility of the SLM Microscope.
14:45	202 c a n c e l l e d	~~**Analysis of heart rate and other physiological variables before, during and after the application of breathing techniques**~~ ~~*Marvin Kovacs, Karl Kratky, Axel Schäfer*~~ ~~*Physics of Physiological Processes, Faculty of Physics, University of Vienna, Boltzmanngasse 5, 1090 Vienna, Austria*~~ ~~The human organism is a highly complex system of intertwined variables, their mutual dependence being not fully understood yet. To determine the impact of controlled breathing on some of these variables, our group has conducted a study regarding the effects of specific yoga breathing techniques (Pranayama). For this purpose we recorded the electrocardiogram, blood volume pulse, thoracic and abdominal breathing amplitude, skin conductance and oxygen saturation during periods of rest, as well as during the performance of breathing exercises. Half of the 30 probands were yoga teachers, the other half students.~~ ~~Our analysis is focused mainly on heart rate variability (HRV) and the correlation between breathing and heartbeat. Without starting from any assumptions we are looking for effects on the various physiological parameters, and examine whether they are influenced by the level of proficiency in Yoga. The results will be presented at the conference.~~

15:00	**203**	**Numerical investigation of the finite helical axis calculation for the healthy human knee joint** *Irene Reichl, Arnold Baca* *Sportwissenschaft, Universität Wien, Auf der Schmelz 6A, 1150 Wien, Austria* Joint kinematics plays a key role in a number of clinical topics. Joint endoprostheses have to be designed and to be placed to reproduce the natural behavior of the joint in question. Ligament replacements need to recover the strength and direction of tension of the original ligament. A kinematical analysis may assist the classification of the joint's functional status before and after therapy or surgical intervention. The quantification of joint translations and the position of the joint's rotational axis/axes or center(s) may indicate joint deficiencies. This contribution applies the concept of the finite helical axis (FHA), first, to simulated data due to a healthy human knee joint model, and, then, to test subjects with asymptomatic knee joints. This study aims to explore the numerical features of the algorithm applied to the healthy case in order to obtain a reference for the envisaged investigations on pathological joints.
15:15	**204**	**Effect of intersubject variability of extrathoracic airways on particle deposition** *Hussain Majid, Werner Hofmann* *University of Salzburg, Hellbrunnerstrasse 34, 5020 Salzburg, Austria* The extrathoracic (ET) airways are the first line of defense against inhaled particles. Since the structure of the ET airway geometry exhibit significant intersubject variations, it affects both ET deposition and, in further consequence, the fraction of inhaled particles reaching the lung. Measured nasal and oral airway dimensions were used in the current study to calculate nasal, oral and total deposition. Nasal deposition was calculated as a function of shape factor Sf and minimum cross sectional area Amin for diffusion and inertial impaction regime, respectively, and oral deposition as a function of equivalent diameter L of the oropharyngeal airway for inertial impaction. Total deposition was calculated by the stochastic particle deposition model IDEAL. Results indicate that the range of the experimentally observed deposition efficiencies could be approximated by 2 standard deviations of the Sf, Amin and L values. This suggests that intersubject variations of ET deposition efficiencies are determined primarily by corresponding fluctuations of these parameters.
15:30	**205**	**A novel time driven photodetector scheme for PET using SiPMs** *Stefan Brunner [1, 2], Thomas Meyer [1], François Powolny [1], Paul Lecoq [1], Pierre Jarron [1], Michel Morel [1], Etiennette Auffray [1], Hartmut Hillemanns [1], Alex Kluge [1], Matthieu Despeisse [1, 3]* *[1] CERN, 1211 Genève 23, Switzerland* *[2] TU Wien, Atominstitut* *[3] EPFL-IMT* Time of flight PET is very demanding in timing precision but can be done with fast PMTs and electronics. If one wants to merge PET with MRI, PMTs are not useable anymore because of their sensitivity to magnetic fields. We present a simple and fast detector scheme using SiPMs and a novel 'time driven' readout technique. With a sigma lower than 170 ps we are by now faster

		than fast PMTs in timing resolution. SPICE simulations let us expect even lower timing resolution figures, basically limited by photon travel time in the detector crystal. Being cheap, simple and fast this new development might be a promising future technology which could compete with state-of-the-art PET and TOF-PET systems and has the ability to be used together with MRI.
15:45		
16:00		***Coffee Break***
		Chair: A. Pochelon, EPFL
16:30	**206**	**Imaging Nanoparticles Uptake in Biological Systems with Wide-Field CARS Microscopy** *Lina Machtoub [1], Saranjam Khan [1], Aleksandar Backovic [2], Marius C. Wick [3], Christian Kremser [3], Stefan Bernet [1], Monika Ritsch-Marte [1]* *[1] Innsbruck Medical University, Sektion für Biomedizinische Physik, Müllerstr. 44, 6020 Innsbruck, Austria* *[2] Innsbruck Medical University, Biocenter, Laboratory of Autoimmunity, Schöpfstraß 41, 6020 Innsbruck, Austria* *[3] Innsbruck Medical University, Department of Radiology, Anichstr. 35, 6020 Innsbruck, Austria* Magnetic nanoparticles have attracted attention in modern medicine and pharmacology owing to their potential usefulness as contrast agents for MRI, as colloidal mediators for cancer magnetic hyperthermia or as active constituents of drug–delivery platforms. The interest in the factors affecting their biodistribution in biological systems after intravenous injection have urged the need to develop methods that can monitor the uptake and metabolic impact of nanoparticles in living systems. A newly developed optical method called "coherent anti- Stokes Raman scattering (CARS)" microscopy is ideally suited for this task, as particles can be visualized in real time with high spatial resolution, and chemical selectivity. We are investigating the mechanism of CARS signal generation of nanopraticles in biological tissues. We present some CARS images that show nanoparticle distribution in some biological systems. With this application we demonstrate the potential of wide- field CARS microscopy for future research on the metabolism of nanoparticles.
16:45	**207**	**Highway Exhaust Aerosols and their Effects on Epiphytic Lichen Populations** *Pierre Madl, Eva Heinzelmann, Werner Hofmann, Roman Tuerk ** *Department of Materials Engineering & Physics, University of Salzburg, Hellbrunnerstr.34, 5020 Salzburg, Austria* ** Department of Organismic Biology* This study investigated the particle inventory of airborne particles originating from an intensely used Motorway that drift into a nearby valley (Nature Preserve) and to investigate correlations between the existence of epiphytic lichen communities and the exposure to these exhaust aerosols. This preserve was chosen because over the past two decades it was found that lichen population density and diversity have decreased under the influence of airborne pollutants. Measurements were carried out on several days during a six-month period using a scanning mobility

		particle sizer. The area is strongly influenced by oscillatory motions of air masses due to solar radiation and characteristic wind directions, thereby facilitating the migration of exhaust fumes into the valley. The investigation of epiphytic lichen populations in the valley confirmed the negative effect of vehicle exhaust pollution and is reflected both in a strongly reduced diversity as well as altered lichen community composition.
17:00	**208**	**Vibrational spectroscopy on pollen grains** *Thomas Zacharias [1], Karin Michalski [2], Maurizio Musso [1]* *[1] University of Salzburg, Department of Materials Engineering and Physics, Hellbrunnerstraße 34, 5020 Salzburg, Austria* *[2] Landeskriminalamt Salzburg, Alpenstraße 90, 5020 Salzburg, Austria* The aim of the project "vibrational spectroscopy of pollen grains", which will be performed within a collaboration between members of the Department of Materials Engineering and Physics of the University of Salzburg and of the Landeskriminalamt Salzburg, will be to compare the standard method of differentiation and identification of pollen grains by their morphology using optical with a non-destructive vibrational spectroscopic method (Raman spectroscopy, infrared spectroscopy), in order to differentiate pollen grains by their chemical composition from the spectral fingerprint obtained, in particular in the cases where optical microscopy fails.
17:15	**209**	**Utilization of elastic scattering of light for characterisation of single aerosol microparticles** *Wladyslaw Szymanski [1], Attila Nagy [2], Aladar Czitrovszky [2]* *[1] University of Vienna, Faculty of Physics, Boltzmanngasse 5, 1090 Wien, Austria* *[2] Hungarian Academy of Sciences, Institute of Solid State Physics and Optics, Konkoly-Thege Miklós út 29-33, 1525 Budapest, Hungary* The effect on climate due to aerosols — small, airborne particles varying in composition, size and shape - is characterized by an uncertainty resulting also from lack of information regarding their impact on radiative forcing. Recent findings show that most of the impact on radiative forcing occurrs at visible wavelengths. That is why we utilize the elastic light scattering for a real-time assessment of refractive index and size of single microparticles. Resulting from the intrinsic nature of elastic light scattering from aerosol particles the non-monotonic size dependence of the scattered light intensity and its variability with changing refractive index of particles influences the function of most conventional particle spectrometers. In order to tackle the problem we propose to employ two illumination laser sources with different wavelengths and four detectors collecting the scattered light in given angular ranges. By making reasonable assumptions regarding the range of particle sizes and of complex refractive indices it will be shown that a unique particle sizing and also an unambiguous determination of the complex refractive indices of measured particles is possible opening new opportunities for single optical particle measurement.

17:30	**210**	**Old and New Cochlear Maps.** *Reinhart Frosch, PSI and ETHZ (retired),* *Sommerhaldenstr. 5B, 5200 Brugg, Switzerland* In the mammalian-cochlea literature there are two "old" cochlear maps (i.e., curves of frequency f versus distance x from the base), namely the passive-peak (PP) map and the low-level active-peak (AP) map. At given x < 0.3L [where L is the length of the basilar membrane (BM)], the frequency f(AP) is higher than f(PP) by ~0.5 octave. This paper defines two "new" maps giving, versus place x, the resonance frequencies f_{res} of two cochlear resonators. The f_{res} of the BM resonator is shown on the "BMR" map. At given x < 0.3L, f(BMR) is higher than f(AP) by ~0.6 octave. The second "new" map, the "IOCR" map, gives f_{res} of the internal organ-of-Corti resonator. The IOCR is thought to represent the second degree of freedom enabling the OHC's to feed energy into the travelling cochlear wave and thus to give rise to the active peak. At given x < 0.3L, f(IOCR) is close to f(PP). Published experimental results demonstrating the BMR and the IOCR will be discussed. Diagrams of the four maps for chinchilla, gerbil, and guinea pig will be shown.
17:45		***END***
19:30		***Conference Dinner***

Time	ID	Applied Physics II: Other Domains *Chair: C. Reichl, arsenal research, AIT Wien*
09:00		***PLENARY SESSION***
12:40		***Postersession, Lunchbuffet***
14:00	221	**Dependency of the quality factor of microcantilevers on pressure and geometry** *Michael Stifter [1], Roman Beigelbeck [1], Wilfried Hortschitz [1], Artur Jachimowicz [2], Franz Keplinger [2], Franz Kohl [1], Matthias Sachse [1], Johannes Schalko [1], Harald Steiner [1], Thilo Sauter [1]* *[1] Institute for Integrated Sensor Systems, OEAW, Viktor Kaplan Strasse 2, 2700 Wiener Neustadt , Austria* *[2] Institute of Sensor and Actuator Systems, Vienna University of Technology, Gusshausstrasse 27-29/366, 1040 Wien, Austria* An experimental study about damping of vibrating cantilevers in their lowest eigenstate is presented. The silicon cantilevers are fabricated by means of micromachined methods. Their size is in the range of 2 mm or less in length, a few 100 µm in width and 20 µm in thickness. The quality factor and resonance frequency are studied as a function of the ambient pressure (0.01 Pa to 100 Pa) and the geometry of the cantilever (plate-type, U-shaped, trapezoidal). The purpose of this research was to obtain design rules for Lorentz forced magnetic field sensors for measuring the components of the exciting magnetic fields with a capacitive read out system. The damping characteristics of microcantilevers in the moleculare regime are performed analytically and with FEM simulation using Comsol Multiphysics.
14:15	222	**Ultrametricity property of energy landscapes of multidisperse packing problems** *Johannes Josef Schneider, Andre Müller, Elmar Schömer* *Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany* We consider the problem of finding the densest closed packing of hard discs with proposed different radii in a circular environment, such that the radius of the circumcircle is minimal. The subspace of the quasi optimum configurations of this problem exhibits the property of ultrametricity. [1] J. J. Schneider, A. Müller, and E. Schömer, Phys. Rev. E 79, 031122 (2009).

14:30	**223**	**Kryokonite: Radionuklidinventar in Gletschern** *Herbert Lettner [1], Alexandra Tieber [1], Thomas Wilflinger [1], Peter Bossew [2], Alexander Hubmer [1], Birgit Sattler [3]* *[1] Abteilung Physik und Biophysik / Fachbereich Materialforschung und Physik, Universität Salzburg, Hellbrunnerstrasse 34, 5020 Salzburg, Austria* *[2] Institute of Environment and Sustainability, DG Joint Research Centre, Radioactivity Environmental Monitoring Group. Via Fermi 1, 21020 Ispra, Italy* *[3] Institut für Ökologie, Universität Innsbruck, Technikerstraße 25, 6020 Innsbruck, Austria* Die radioökologische Diversität in Kryokoniten, einem mineralisch-organischem Sediment auf und in Gletschern, ist überraschend groß. Das Radionuklidinventar enthält radioaktive Substanzen aus der Zeit der Kernwaffenversuche, dem Tschernobyl Fallout und in nicht unerheblichen Mengen natürliche Radionuklide, die über Aerosole laufend deponiert werden. Mithilfe von Isotopenverhältnissen, wie $^{137}Cs/^{134}Cs$ und $^{238}Pu/^{239+240}Pu$ ist es möglich, Quellen zu identifizieren und ihre anteilsmäßigen Beiträge abzuschätzen. Wenn auch Tschernobyl- Fallout allgemein dominiert, so zeigt sich doch, dass alte Kryokonite existieren, die nur wenig Tschernobyl-Anteil aufweisen. Aus der räumlichen Verteilung der Kryokonite, dem Inventar und dem Mischungsanteil der einzelnen Beiträge wird versucht Hypothesen zu entwickeln zu Ursprung, Entstehung und Zyklierung von Kryokonit auf und in Gletschern, sowie zu ihrer Rolle im Prozess des Abschmelzens der Gletscher durch globale Erwärmung.
14:45	**224**	**BEC of dark excitons in stress-induced potentials** *Zoltan Vörös [1], David Snoke [2], Loren Pfeiffer [3], Kenneth West [3]* *[1] University of Innsbruck, Technikerstraße 25/4, 6020 Innsbruck, Austria* *[2] University of Pittsburgh, Department of Physics and Astronomy, 100 Allen Hall, 15260 Pittsburgh, United States* *[3] Bell Labs, Lucent Technologies, 08978 Murray Hill, United States* While it has long been known that the ground state of spatially indirect excitons is optically inactive, its relevance to Bose-Einstein condensation (BEC) has been overlooked. In this contribution, we review our experiments on trapped excitons, and the role of dark states. In order to confine the particles in the quantum wells, we apply stress-induced band-deformation to create macroscopic and harmonic traps. At moderate stress (or weak confining potential), the exciton luminescence (i.e., the ensemble of bright excitons) has a distribution dictated by the temperature and the shape of the trap. However, while keeping the particle number constant, by increasing the stress, a distinct and well-localised dark region develops at the centre of the trapping potential. We will consider evidence that this dark region is an ensemble of dark excitons, and we will discuss how this new phase transition depends on various experimental parameters, such as, the strength of the potential, the temperature and the particle density.

15:00	**225**	**Influence of surface roughness on localised surface plasmons** *Claude Leiner, Andreas Hohenau, Joachim R. Krenn, Daniel Koller, Nicole Galler, Alfred Leitner, Franz R. Aussenegg *, Harald Ditlbacher, Norbert Reitinger* *Institute of Physics, University Karl-Franzens-Graz, Universitätsplatz 5, 8010 Graz, Austria* ** Erwin Schrödinger Institute for Nanoscale Research, Universitätsplatz 5, 8010 Graz, Austria* Plasmonics is one of the major parts of nano-optics. When light hits a gold nano-particle which is smaller than the wavelength, it can resonantly excite coherent electron oscillations (localised surface plasmons) with a strong optical near field enhancement. This effect is promising for several applications in sensor technology. The spectral position and strength of localised surface plasmons depends on the shape and the roughness of the nano-particle. We investigate the influence of nanometric surface roughness of gold nano-particles on the optical near fields with the aim to optimise them. We modify the surface roughness by varying the production parameters and by following annealing. Our investigation methods include AFM, SEM and spectrometry. Our results indicate sharper resonance peaks in the absorbance spectrum for smoother surfaces.
15:15	**226**	**Single beam optical trapping at long working distances** *Maximilian Pitzek, Sektion für Biomedizinische Physik, Müllerstraße 44, 6020 Innsbruck, Austria* Optical tweezers (OT) have evolved to an important device in biophysical research. In conjunction with an SLM (Spatial Light Modulator) OT setups provide a very versatile instrument for micro manipulation in all 3 dimensions with variously shaped optical traps. However, a disadvantage of OT setups is that working distances are usually very small since tweezers have been built solely at high NA so far. This is due to the fact that at low NA trapping in axial direction does not work anymore since scattering forces exceed gradient forces in this situation. There have been proposals to overcome this restriction by using two antagonized laser beams, here we show a new method to achieve trapping at low NA with only one beam.
15:30	**227**	**Analytic solution for the Gaussian closure based on the Bouc's hysteresis model** *Holger Waubke, Acoustics Research Institute, OEAW, Austrian Academy of Sciences, Wohllebengasse 12-14, 1040 Vienna, Austria* Bouc's hysteresis has become famous for the mathematical description of hysteretic material behaviour. An exact description of the probability densities is provided by Kolmogorov's equation. This is a partial differential equation depending on time and on the state vector variables. No analytic solution is possible. Therefore numerical approaches are developed. An approximation of the statistical moments of the distribution is possible by the moment closure techniques. In these methods always more moments are present then equations are given. The Gaussian Closure assumes that the distribution is of Gaussian type and the higher moments are derived from the first and second order moments. A physical model of a dynamic system with two degrees of freedom and hysteretic behaviour is presented.

15:45	**228**	**Acoustic pressure fluctuations in turbulent impinging jets – spectral comparison of numerical and experimental data sets** *Christoph Reichl [1], Michelle Böck [1], Wolfgang Tilser [1], Helmut Kühnelt [1], Klaus Haindl [2], Martin Opitz [2]* *[1] arsenal research - Austrian Research Centers, Giefinggasse 2, 1210 Wien, Austria* *[2] AKG Acoustics GMBH, Lemböckgasse 21-25, 1230 Wien, Austria* Nozzle designs in ventilation systems have a strong impact on turbulence, acoustic pressure fluctuations and acoustic radiation in the emerging jets. It is highly interesting to be able to model these turbulent flows and to characterize the spectral content of the pressure perturbations. For this purpose, a turbulent circular pipe-flow has been generated by an axial symmetric fan. Different turbulence generators consisting of meshes, rods, cubes and spikes generate the turbulent flow field downstream of the pipe outlet, which is analysed using two-axis hot wire anemometry on a three-axis traverser. A set of 12 microphones is used to capture wall pressure fluctuations and off axis sound fields. CFD calculations are performed using steady RANS and transient DES numerical approaches, which generate the base for the extraction of fluctuating velocity and pressure time series. The spectral content of the time series for the different jets is compared to the experimental values.
16:00		***Coffee Break***
		Applied Physics III: Thin Films, Molecular Physics and Materials *Chair: A. Kendl, Uni Innsbruck*
16:30	**231**	**Ag induced structures on an oxygen pre-covered Cu(110) surface** *Thomas Brandstetter, Thorsten Wagner, Peter Zeppenfeld* *Experimental Physics, Johannes Kepler Universität, Altenbergerstrasse 69, 4040 Linz, Austria* The Cu(110) surface can be readily structured by adsorbing oxygen: If the coverage of oxygen is less than required to form a complete (2x1) overlayer, CuO stripes are formed which are separated by bare copper areas. These stripes are uniformly distributed and parallel to the [001] direction. On such an oxygen pre-covered surface silver was adsorbed at 660K. As revealed by scanning tunneling microscopy, submonolayer silver coverages lead to a phase separation between CuO and Ag/Cu alloy areas. The original Cu-CuO stripe phase is destroyed and larger CuO areas ('ponds') are formed. They are separated by Ag like stripes which are again parallel to the [001] direction. The use of this structure as a template for additional adsorption of Ag at 300K leads to the formation of 3D nanorods along the perpendicular [1-10] direction as known for Ag grown on clean Cu(110). Since on our template the nanorods only grow on the Ag like stripes, their length is limited by the width of these stripes. With this technique one can even change the aspect ratio of the rods such that their longer axis is now parallel to the [001] direction.

16:45	**232**	**Nano-ice on h-BN/Rh(111): a two dimensional gas-solid phase system** *Haifeng Ma [1], Yun Ding [2], Thomas Brugger [1], Simon Berner [1], Marcella Mauri-Iannuzzi [2], Jürg Hutter [2], Jürg Osterwalder [1], Thomas Greber [1]* *[1] Physik-Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland* *[2] Institute of Physical Chemistry, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland* Boron nitride nanomesh, a single layer of hexagonal boron nitride on Rh(111), is a corrugated superstructure with a lattice constant of 3.2 nm, where 'holes' and 'wires' constitute distinct bonding regions for molecules [1]. The adsorption behavior of water on this surface is investigated by variable temperature scanning tunneling microscopy and spectroscopy. Below the water desorption temperature two distinct phases of water are identified: In the 2 nm holes an ordered high density phase of nano-ice crystals with about 40 molecules and on the wires, a low density gas phase is found. The wires connect individual nano-ice clusters and enable fast mass transport between them. [1]. S. Berner, M. Corso, R. Widmer, O. Gröning, R. Laskowski, P. Blaha, K. Schwarz, A. Goriachko, H. Over, S. Gsell, M. Schreck, H. Sachdev, T. Greber, and J. Osterwalder Boron Nitride Nanomesh: Functionality from a Corrugated Monolayer. Angew. Chem. Int. Ed. 46 (2007) 5115.
17:00	**233**	**Interacting traveling current filaments and spreading fronts in sandwiched semiconductor nanostructures** *Dionyz Pogany [1], Sergey Bychikhin [1], Wasinee Mamanee [1], Erich Gornik [1], David Johnsson [2], Kai Esmark [2], Harald Gossner [2], Matthias Stecher [2], Pavel Rodin [3]* *[1] Solid State Electronics, TU Wien, Floragasse 7, 1040 Wien, Austria* *[2] Infineon Technologies AG, Am Campeon 1-12, 85579 Neubiberg, Germany* *[3] Ioffe Physicotechnical Institute, Polytechnicheskaya 26, 194021 St. Petersburg, Russian Federation* Current flow in semiconductor devices with S-shaped current voltage (IV) characteristics exhibits different spatial and temporal instabilities that can lead to formation of stationary or non-stationary current density patterns. Npn or npnp layered structures are often used as protection devices in IC chips. Since they exhibit the S-shape IV characteristics, the understanding of spatio-temporal dynamics of current flow is of great interest. Here we analyze traveling current filaments (CFs) and spreading fronts in advanced silicon structures using the transient interferometric mapping (TIM) technique and a simulation based on a simplified non-linear dynamics model. A thermally-induced current redistribution between multiple traveling CFs has been analyzed in npn devices. The CF motion (speed approx. 1000m/s) is induced by the negative temperature coefficient of the impact ionization process. The spreading fronts are studied in 90nm advanced CMOS technology npnp devices.

17:15	**234**	**Post-fabrication Fine-tuning of Photonic Crystal Devices** *Stefan Kalchmair [1], Stephan Schartner [1], Aaron Maxwell Andrews [1], Pavel Klang [1], Oleksandr Glushko [2], Ronald Meisels [2], Werner Schrenk [1], Gottfried Strasser [1]* *[1] Center for Micro- and Nanostructures, Vienna University of Technology, Floragasse 7, 1040 Wien, Austria* *[2] Department of Physics, University of Leoben, Franz-Josef-Straße 18, 8700 Leoben, Austria* Photonic crystals (PhC) are desired for their fascinating properties like photonic bandgaps or negative refractive indices. For mid-infrared frequencies, their structures are on the micrometer scale, but with nanometer tolerances. To exploit their full potential, it is necessary to precisely control the dimensions and hereby the resonant behavior of the PhC, which is difficult to achieve even by state-of-the-art semiconductor processing. Post-fabrication tuning with dielectric materials offers a convenient solution. Our PhCs were processed into a quantum well infrared photodetector to accurately measure the tuning-shift. By sidewall-deposition of thin layers of silicon nitride (SiN_x), using plasma enhanced chemical vapor deposition, the PhC resonance was stepwise shifted to lower wavenumbers. After each deposition step, photocurrent spectra were measure and finally a tuning coefficient of $\partial\nu/\partial d_{SiN}$ = -0.06 cm^{-1}/nm was extracted. This allows precise post-fabrication resonance tuning in many PhC devices. This work was supported by the Austrian NANO Initiative RPC PLATON.
17:30	**235**	**3D FDTD simulations of photonic devices** *Ronald Meisels [1], Oleksandr Glushko [1], Stefan Kalchmair [2], Gottfried Strasser [2]* *[1] Institute of Physics, University of Leoben, Franz Josef Strasse 18, 8700 Leoben, Austria* *[2] Center for Micro- and Nanostructures, TU Vienna, Floragasse 7, 1040 Vienna, Austria* In our contribution we will present the recent results on 3D simulations of photonic devices. Particularly, quantum well infrared photodetectors with embedded photonic crystal are optimized to achieve optimal light coupling and quantum efficiency. Furthermore, we study schemes of light coupling into SOI waveguides. Both optical fibre-SOI waveguide and laser-SOI waveguide coupling schemes are investigated. The results of investigations regarding the influence of disorder on the reflection peak in opal 3D photonic crystal will be also presented. This work was supported by the Austrian Nanoinitiative RPC PLATON.
17:45	**43**	***Winner of the SPS Award for Applied Physics, sponsored by OC Oerlikon***
18:15		***END***
19:30	**21**	***Public Lecture***

ID	Applied Physics Poster
241	**Characterization of single ZnO nanorods by conductive atomic force microscopy** *Igor Beinik [1], Markus Kratzer [1], Lin Wang [1], Gerhard Brauer [2], Wolfgang Anwand [2], Christian Teichert [1]* *[1] Institute of Physics, University of Leoben, Franz Josef Straße 18, 8700 Leoben, Austria* *[2] Institut für Ionenstrahlphysik und Materialforschung, Forschungszentrum Dresden-Rosendorf, 01314 Dresden, Germany* ZnO nanostructures are promising candidates for applications in solar cells, piezo actuators, and energy harvesting devices due to the wide band gap and the piezoelectric properties of this material. In this study the morphology and the electrical properties of differently prepared ZnO nanorods (NR's), grown on Si(100), have been investigated by scanning probe microscopy. The samples were prepared either hydrothermally (HT) or by thermal evaporation (TE). The shape and diameter distributions of the NR's were measured by tapping mode atomic force microscopy (TM-AFM). In order to determine carrier transport properties, current-voltage (I/V) spectroscopy on the individual upright standing NR's has been applied, utilizing conductive atomic force microscopy (C-AFM). These were correlated to the topography images. Additionally, I/V-curves were recorded in the centre of the top terrace of single NR's to obtain information on electrical characteristics. Support by the FWF project Nr. P19636 is acknowledged.
242	**Processing of vertical-aligned Si-Nanowire-arrays for next generation CMOS devices** *Ole Bethge, Stephan Abermann, Christoph Henkel, Emmerich Bertagnolli* *Institute for Solid State Electronics, Floragasse 7, 1040 Vienna, Austria* Silicon nanowires experience a considerable increase in attention, as the number of publications in this field doubles about every two years. A variety of applications has been demonstrated, for example sensor- [1], optical- [2] and electronic devices [3]. We demonstrate a fabrication scheme for Si-Nanowire-arrays in a top-down-process by means of Reactive-Ion-Etching down to 20 nm diameter with an aspect ratio of 1:20 for novel electronic device architectures. Furthermore, we show the applicability of Atomic Layer Deposition to coat such structures with high-k oxides and metal-gate layers. [1] Z. Fan et al, Appl. Phys. Lett. 86 (2005) 123510. [2] R. Koenenkamp et al, Appl. Phys. Lett. 85 (2004) 6004. [3] C. Thelander, Nano Lett. 5 (2005) 635.
243	**Ultrathin Mn films on Rh(100) studied by STM** *Albert Biedermann, Fabian D. Natterer* *Faculty of Physics, University of Vienna, Boltzmanngasse 5, 1090 Wien, Austria* Mn alloys are typically used as antiferromagnetic pinning layers in spin valves. Pure fcc Mn films are also antiferromagnetic (e.g. Mn/Cu_3Au [WC Lin et al., Phys Rev. B 75, 054419, 2007]) but only above a certain critical thickness, where the tetragonality, i.e., the interlayer distance changes by about 5%. We present an overview of the phenomenology near this critical thickness for the system Mn/Rh(100), which provides almost perfect lattice matching for fcc Mn. The first ML shows individual vacancies stable enough for imaging by STM at

300 K. The second ML tends to decay into coexisting one- and three-ML regions. Between 3 and 5 ML, the interlayer distance, estimated from local step heights, changes from fcc to fct values, indicating the transition to the layered antiferromagnetic phase.

244 **Response of dual-wavelength optical particle spectrometer (DWOPS) to well-defined aerosols**

David Dannhauser [1], Attila Nagy [2], Aladar Czitrovszky [2], Wladyslaw Szymanski [1]
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It is a recognized fact that more information is contained in the spatial distribution of light scattered from a particle than is currently used in conventional spectrometers. Employing multiple detectors to study the elastically scattered light gives access to a description of a particle size, leading also to information on a particle's refractive index and maybe shape. The DWOPS measures and evaluates light scattered from an individual particle into four different angular ranges. This data corresponds to theoretically determinable instrument's responses for a given particle. A fit procedure finds the quadruple of theoretical values best matching the quadruple of measured values. Experiments with well-defined spherical, homogeneous aerosols will be reported and show that a unique particle sizing and also an unambiguous determination of the complex refractive indices of measured particles is possible. It must be mentioned that the particle measurement and evaluation of performance is based on the postulation of sphericity of aerosols in question, which may be assumed for many submicron atmospheric particles. The irregular shape of particles is an inherent difficulty in single optical particle spectrometry. Preliminary measurements with DWOPS are promissing in dealing with this issue.

245 **Towards the creation of a quantum gas of polar ground state molecules**

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The creation of quantum gases of deeply bound ground state molecules (c.f. Danzl et al.[1] and Ni et al. [2]) has attracted a lot of attention in recent months. In these experiments, high phase space density samples of molecules are first produced by means of Feshbach association out of quantum degenerate gases. The molecules are then transferred to the ground state by stimulated two-photon transfer. In our Rb-Cs mixture experiment the focus is directed towards the creation of a quantum gas of polar ground state RbCs molecules using similar transfer schemes. Currently we are working towards the creation of a double Rb-Cs Bose-Einstein condensate (BEC) as a starting point for efficient molecule creation and on implementing stimulated Raman adiabatic passage (STIRAP) transfer to the rovibronic ground state. To find suitable optical transitions for the STIRAP transfer we intend to perform detailed spectroscopic measurements on RbCs Feshbach molecules. We present our setup and report on the status of the experiment.

[1] J.G. Danzl et al., Science 321, 1062 (2008).
[2] K.-K. Ni et al., Science 322, 231 (2008).

246 Synthesis and characterization of β-phase $(Bi_2O_3)_{1-x-y}(Ho_2O_3)_x(Eu_2O_3)_y$ ternary solid solution

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Solid electrolytes such as polymorphs of Bi_2O_3 are essential components in the production of solid state electrochemical devices especially solid oxide fuel cell (SOFC), due to their high oxygen ionic conductivity. In this study, the polymorphic phase transitions, crystallographic and electrical properties and Ho_2O_3-Eu_2O_3 content dependence of the lattice parameters of the ternary $(Bi_2O_3)_{1-x-y}(Ho_2O_3)_x(Eu_2O_3)_y$ system have been investigated. The dominant β-phase of the system has been obtained at 700°C. It has been found that, the unit cell parameters of the β-phase system increase slightly with the increasing Ho_2O_3 content. In order to understand the mechanisms of the ionic oxygen conductivity of the system, possible explanations depending on the electrical, structural and morphological properties will be discussed.

247 Characterization of ternary solid electrolyte $(Bi_2O_3)_{1-x-y}(Gd_2O_3)_x(Eu_2O_3)_y$

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The aim of this study is to investigate the polymorphic phase transitions, crystallographic and electrical properties and Gd_2O_3-Eu_2O_3 content dependence of the lattice parameters of the ternary solid solution $(Bi_2O_3)_{1-x-y}(Gd_2O_3)_x(Eu_2O_3)_y$. The SEM, XRD, TG/DTA and electrical measurements have been carried out in order to clarify structural and thermo-electrical transport properties. The mechanisms of the ionic oxygen conductivity of the system have been discussed by using the electrical and structural measurement results. The dominant β-phase of the system has been obtained at 700°C. The obtained unit cell parameters of the system increase with the increasing Gd_2O_3 content. This ternary solid solution can be used as an essential component in the production of solid state electrochemical devices especially solid oxide fuel cell (SOFC), due to their high oxygen ionic conductivity.

248

Quantitative Measurement of Blood Cells

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We are observing and measuring the varying development reaction stages of blood cells to different saline solutions. The imaging process is based on a common path interferometer which is realized with a spatial light modulator (SLM) in the Fourier plane after the microscope objective. With the SLM we can shift the phase of the transmitted light with respect to the phase of signal wave. This principle is used for the phase contrast microscopy method where we take four pictures of the same image with different phase shifts in order to calculate the complex field of the measured cell. This microscope technique obtains quantitative data about the blood cell's surface in different development stages, amplitude and phase differences inside the cell itself.

249

Deterministic reordering of calcium ions in a linear, segmented Paul-trap

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Segmentation of ion traps is a promising route to allow the major results in trapped-ion quantum computing to be extended beyond individual traps, to many ion trap systems. In such a system, ions must be shuttled and sorted into different arrangements, dependent on the algorithm being used. The ability to deterministically reorder ions within a linear string is therefore a crucial building block for ion quantum computation in segmented traps. Earlier experiments of other groups have demonstrated the exchange of two ions in complex trap structures using junctions.
Here the exchange of two calcium ions is achieved in a linear, segmented surface ion trap without the need for dedicated electrodes. An exchange fidelity of 98% is obtained, and the ion heating is below 1 meV per exchange. Theoretical considerations show that this procedure is also applicable to ion traps with a typical two-layer design. The progress on the operation of such a trap will be discussed.

250

Two ways of looking at the intermediate position of binary alloys – Pulse heating results of NiCr and CuNi alloys.

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The measurements of NiCr and CuNi alloys show two examples to interpret binary alloys: at one hand to study selected properties while changing the concentration of the respective pure constituents (phase diagrams are the paradigm of this first approach). At the other hand, binary alloys have an intermediate position between pure elements and highly alloyed materials as used for industrial applications.
Five CuNi alloys have been investigated to follow the first considerations – this might be called a 'horizontal approach'. A 'vertical approach' has been exercised on $Ni_{80}Cr_{20}$, which is set in context to its pure constituent elements and to the highly alloyed material Inconel 718.

The two approaches are not new at all, but they are a starting point to test the performance of fast pulse-heating when being applied to simple and more complex alloys. The high heating rates, which are characteristic for this kind of experiments, influence the solid - liquid phase transition in contrast to phase diagrams which are obtained at thermodynamic equilibrium. Preliminary results on CuNi alloys show good agreement to data measured under quasi static conditions in levitation experiments, which indicates that the loss of thermodynamic equilibrium does not necessarily lead to big deviations.

The project Electrical Resistivity Measurement of High Temperature Metallic Melts is sponsored by the Austrian Space Applications Programme (ASAP) of the FFG, Sensengasse 1, 1090 Wien, Austria.

251 ^{137}Cs in Pilzen im alpinen Raum

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Pilze reichern aufgrund ihrer Physiologie und ihres hauptsächlichen Vorkommens in nährstoffbegrenzten Waldökosystemen künstliche Radioaktivität, und vor allem ^{137}Cs, in einem Ausmaß an, das unter gewissen Bedingungen und Wahrscheinlichkeiten zu Konzentrationen führt, die deutlich über den EC-Grenzwerten (600 Bq/kg) liegen können. Noch 2006 konnten in einer groß angelegten Beprobung in Salzburg, Oberösterreich und im Gebiet der Koralpe bei vielen Speisepilzen, z.B. in mehr als 65 % aller Maronenröhrlinge, (Xerocomus badius) Überschreitungen dieses Grenzwertes festgestellt werden. In diesem Beitrag wird ein Überblick gegeben über die Belastungssituation der wichtigsten Speisepilze, der Abhängigkeit von der örtlichen Kontamination, ihrer räumlichen Verteilung in den Untersuchungsgebieten und über die Erstellung einer daraus abgeleiteten Risikokarte.

252 Ni doping effect on structural and magnetic properties of $La_{(1/3)}Sr_{(2/3)}Fe_{(1-x)}Ni_{(x)}O_{(3-\delta)}$

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$La_{(1/3)}Sr_{(2/3)}Fe$-oxide which is in ABO_3 structure is very well-known as charge ordering material [1] and shows antiferromagnetic transition at around 200 K at high (1T) magnetic field. In addition to this transition, we observed another transition at around 175 K at low field of 500 Oe, which was not observed at lower field of 150 Oe. We extend our studies on the B-site doping with Nickel, which makes the material more conducting and more magnetized. Therefore, a set of compounds in the formula of $La_{(1/3)}Sr_{(2/3)}Fe_{(1-x)}Ni_{(x)}O_3$ (x = 0.1, 0.15, 0.2) were prepared by soft chemistry method. From the X-ray powder diffraction it was observed that all of the samples were in single perovskite phase. The temperature and field dependent magnetic properties of the samples were investigated by using Physical Properties Measuring system (PPMS) and it was observed for all the samples there is a difference between magnetization upon heating and cooling at a constant field. The sample with x=0.15 shows the highest magnetization at the field of 1T but it has lowest magnetization at field of 500 Oe. The field dependent magnetization behavior of these samples suggests anisotropy of magnetization, the magnetic moments may have different size and different orientations because the Fe-O octahedral in the perovskite structure are often tilted or canted, and so is the magnetic moment.

[1] T. Ishikawa, S.K. Park, T. Katsufuji, T. Arima and Y. Tokura, Phys. Rev. B 58 (1998), p. R13 326.

253

Structural characterization of surface-functionalized nanoparticles and nanocomposites by small angle X-Ray scattering

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One of the driving forces in the development and chemical optimization of inorganic-organic nanocomposites is the substitution of traditional compounds, such as metals, ceramics or polymers, with superior physical properties. An example for the need of nanocomposites is the replacement of heavy weight materials, which cause a quite bad fuel economy in transportation industry, by novel light systems with similar or even better properties. Inorganic-organic nanocomposites often show excellent mechanical properties if the inorganic nanobuilding blocks such as nanoparticles are crosslinked with the organic matrix. This is achieved by surface-functionalization of the nanoparticles. Structural characterization of the resulting nanocomposites is performed by small angle X-ray scattering (SAXS) measurements: From the SAXS intensity, information on the size of nanoparticles and their aggregation behaviour is obtained. The effect of different surface-functionalization and different amounts of surface coverage on the aggregation behaviour of the nanoparticles within the nanocomposites are presented.

254

Effects of thermal conductive pastes on temperature dependent Hall measurements

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The effects of four thermal glues (cry-con ©, fixogum © RS 503-357 © and silicon-highvacuum-grease from Leybold vacuum ©) are tested in temperature dependent Hall measurements. All thermal glues yielded the same results between 300 K and 190 K. RS 503-357 © drastically distorts below 190 K, probably due to a phase transition that renders it a thermal insulator, heating the sample during the phase transition. All the other thermal glues give reproducible results down to 100 K. Below 100 K, cry-con ©, fixogum © and the silicon-highvacuum-grease from Leybold vacuum © give the same behaviour but with different magnitude. This is explained as the thermal properties of each glue start to diverge. Fixogum © seems to give the best thermal transfer, while the silicon-based (which is not intended as conductive paste) is worst below 100 K. Crycon © has an intermediate behaviour between these two former ones. The cooling speed plays an important role at these low temperatures.

255

Thermal diffusivity of $X_{153}CrMoV_{12}$ – a methodological study

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The main target of a recent research project in cooperation with Böhler Edelstahl GmbH & Co KG is to compare different methods for thermal diffusivity measurements of highly

alloyed steels. For this reason, thermal diffusivity is on one hand directly measured via Laser Flash Analysis (LFA) and, on the other hand, indirectly calculated from electrical resistivity using the Wiedemann-Franz-Law. Therefore, electrical resistivity (in the solid and the liquid states) needs to be known and is within the frame of this investigation measured using a fast pulse-heating apparatus. However, material-dependent lattice contributions of yet unknown magnitude need to be accounted for.
A relation between direct and indirect methods is sought after to improve measurements and simulations using the Wiedemann-Franz-Law. As a first step, a $X_{153}CrMoV_{12}$ steel of industrial relevance is investigated using both mentioned methods. The measured diffusivity results will be compared and presented within this study. The examination of other alloys is in preparation and will possibly help to quantify these lattice contributions for selected groups of alloys.

The project "Lorenz-Zahl und Temperaturleitfähigkeit von hochlegierten Stählen" is supported by the Böhler Edelstahl GmbH & Co KG and the Österreichische Forschungsförderungsgesellschaft mbH (FFG), Sensengasse 1, 1090 Wien, Austria under project # 812972

256 On the Problem of Finding a Suitable Distribution of Students to Universities in Germany

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Since many years, the problem of how to distribute students to the various universities in Germany according to the preferences of the students remains unsolved. Various approaches, like the centralized method to let a central agency organize the distribution to the various universities or the decentralized method to let the students apply directly at their preferred universities, turned out to lead to a significant fraction of frustrated students ending up at universities not being on their preference list or even not having a place to study at all. With our centralized approach, we are able to decrease the fraction of frustrated students as well as the bureaucratic expenses for applicants and universities drastically.

257 Highly stable high power fiber laser system for optical trapping of ultracold atoms

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For our quantum gas experiments we simultaneously confine ultracold Rb and Cs atoms in an optical dipole trap. For that purpose the light of a commercially available, narrow-band, single mode 1064-nm solid-state laser is amplified in a home-built fiber amplifier using a Yb-doped large mode area (LMA) fiber. The fiber is pumped by a high-power 980-nm diode laser and yields an (amplified) narrow-band optical output of more than 30 W for an input seed power of about 1 W at 1064 nm. The performance of this fiber amplifier is presented in terms of slope efficiency, relative intensity noise (RIN), and long term stability. The light of the fiber laser is used for optical trapping of the quantum gas mixture in running wave and standing wave dipole traps.
We present our progress towards the realization of a 3D optical lattice for the realization of strongly correlated quantum gas mixtures and for the study of quantum gas mixtures in low-dimensional geometry.

258

Shaped Beams in Vertically Emitting Quantum Cascade Ring Lasers

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Since the mid-infrared (MIR) and terahertz (THz) regime of the electromagnetic spectrum is rich in absorption resonances, applications like chemical sensing and spectral imaging call for reliable coherent emitters with well defined beam profiles. We demonstrate the simulation, design, fabrication and operation of surface emitting MIR and THz quantum cascade ring lasers (QCL) that hold second-order gratings to allow for radiation out-coupling. The emitting area naturally forms a circularly shaped far field and the overall large emission area narrows the beam, making bulky and expensive optics obsolete. The capability of beam shaping is achieved by tuning the grating period, resulting in spot- and ring-shaped symmetric far-field patterns. The emitters exhibit robust single mode operation with a side mode suppression ratio higher than 25dB, for all bias currents and temperatures. A strong reduction of the beam divergence was observed for MIR and THz QCLs, with a full-width-at-half-maximum of 3° and 15°, respectively.

259

Single beam optical trapping at long working distances

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Optical tweezers are commonly used in recent biophysical work, providing a perfect instrument for contact free sample manipulation. Numerous applications and techniques have been proposed. Scattering forces in the trap have so far constrained optical tweezers setups to high numerical aperture objectives. At low numerical apertures the axial trapping force can not exceed the scattering force which always acts in propagation direction. However a high numerical aperture means a short working distance which imposes various problems e.g. when trying to introduce additional imaging. We propose a new setup which makes low NA 3D trapping possible by using only one single laser beam.

260

Speciation of Pb in the tidemark of human articular Cartilage using micro-XRF-XANES

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The vast majority of the toxic tracelement lead (Pb) is stored in the skeleton. We have recently shown that Pb specifically accumulates in the tidemark (TM) of human articular cartilage at much higher levels compared to trabecular bone. However, the accumulation mechanisms as well as the chemical species of Pb at the TM, which is the border between calcified and

non-calcified articular cartilage, are unknown.
To check if X-ray absorption spectroscopy is feasible to determine the chemical form of Pb in human bones, we recorded Pb L3 edge EXAFS spectra at the TM of a human femoral head and of a synthetic apatite with 400 ppm Pb as reference substance. Since the estimated thickness of the TM is in the order of 10-20 µm it is necessary to measure the spectra with a small beam focus (here about 150 µm x 150 µm) as it is available at the X-ray beamline of the Synchrotron Radiation Laboratory for Environmental Studies (SUL-X) of the synchrotron radiation source ANKA. Fluorescence radiation was collected with a 7 element Si(Li) detector (Gresham, now e2v) at SUL-X and with a 5 element Ge detector (Canberra) at ANKA-XAS. In both cases a silicon (111) crystal pair with a fixed beam exit was used as monochromator.
The results suggest that most of the tidemark-Pb might be incorporated into the apatite structure.

261

STM/LEED-study of ZnO films on Pd(111)

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One of the challenges of modern science is the development of a safe mobile hydrogen supply for fuel cells. One possible approach to achieve this goal is via steam reforming of methanol into molecular hydrogen and carbon dioxide. The material combination of Pd/ZnO is considered to be one of the most promising candidates for the catalysis of this process. In our studies we use an inverse model catalyst consisting of ZnO-layers on top of a Pd(111)-surface. This system is investigated with scanning tunneling microscopy (STM) and low energy electron diffraction (LEED).We will present the progress of our research and in this context we will show data about the growth and structure of the grown ZnO-films, the dependence on the oxygen pressure and interaction between Pd and ZnO.