Program of the 3rd NanoCharM School

Sunday afternoon, 28th Feb.

Speaker	Title	Time
Losurdo	Motivation for NanoCharm and its Goals	14.00-14.20
Irene	Basics of ellipsometry	14.30-15.30
Break	-	15.30-16.00
Aspnes	Optical Properties of Solids I	16.00-17.00
Hingerl	Representation of Polarization	17.10-18.00

Dinner: 18.30

Sunday evening, 28th Feb.

Schubert	Terahertz to Infrared Ellipsometry and the Optical Hall effect	20.00-21.00

Monday morning, 1st Mar.

Aspnes	Optical Properties of Solids II	08.30-09.30
Hingerl	Effective medium models	09.40-10.30
Break	-	10.30-11.00
Irene	Monitoring chemical processes with SE	11.00-11.50
Losurdo	Dispersion relations for a., c, nc, pc SI	11.50-12.20

Lunch 12.30

Coffee 16.30

Monday afternoon, 1st Mar.

Aspnes	Band structure and reciprocal space analysis	17.00-18.00
Humlicek	Propagation of light in layered materials	18.10-19.10

Dinner 19.30

Monday evening, 1st Mar.

Cardona	Dependence of Optical Spectra on Temperature and Isotopic Mass	21.00-22.00

Tuesday morning, 2nd Mar.

Gajic	Optical properties of metallic nanostructures	08.30-09.30
Hingerl	Anisotropic samples and generalized ellipsometry	09.40-10.30
Break	-	10.30-11.00
Sun	RAS	11.00-11.45
Esser	Introduction to RAS	11.45-12.15

Lunch 12.30

Coffee 16.30

Tuesday afternoon, 2nd Mar.

Krenn	Introduction to plasmonics	17.00-18.00
Rockstuhl	Introduction to metamaterials	18.10-19.10

Dinner 19.30

Tuesday evening, 2nd Mar.

Poster Session	20.30 – 22.00

Wednesday morning, 3rd Mar.

Enric Garcia-Caurel	Characterization of gratings	08.30-09.30
Zeppenfeld/Bergmair	Ellipsometry of Gratings	09.30-10.30
Break	-	10.30-11.00
Keilmann	Phase-resolving spectroscopy of metamaterials and nanostructures	11.00-12.00
Cattelan	Industrial applications of polarimetry	12.10-12.30

Lunch 13.00

Coffee 16.30

Wednesday afternoon, 3rd Mar.

Weightman	The study of biological systems using optical techniques	17.00-18.00
McGilp	Second Harmonic Generation	18.10-19.10
Aspnes	Bond hyperpolarization model	19.15-19.45

Dinner 20.00

Thursday morning, 4th Mar.

Richter	Introduction to Raman Spectroscopy	08.00-09.00
Ossikovski	Müller matrix measurements	09.00-10.00
Info (short break)	Ski race	10.00-10.15
Bechstedt	Calculation of opt. Spectra from first principles	10.15-11.15

Lunch 11.30

Skirace 14.30

Coffee 17.00

Thursday evening, 4th March

Zahn	Introduction to organic materials and small molecules	17.30-18.30
Cobet/Hinrichs	VUV and FIR ellipsometry	18.40-19.20
Losurdo/Bruno	Ellipsometry for Photovoltaics	19.20-20.00

Conference Dinner and winners ceremony 20.15

Friday morning, 5th March

Heise	Polarization Sensitive Optical Coherence Tomography	09.00-09.30
Bonanni	Nitride and related compounds	09.30-10.30
Break	-	10.30-11.00
Losurdo/Esser/Humlicek	School wrap up	11.00-11.30

Lunch 12.00 and farewell

School Objectives
The winter school is the 3rd school in the frame of the EU Project NanoCharM. The lectures are separated in basic and advanced levels. A special focus will be set on plasmons and negative refraction structures.

Venue:

The winter school will be held in Bad Hofgastein in the province Salzburg, Austria. Bad Hofgastein is a market town located in the Gastein valley in the Austrian Alps. Therefore it offers a scenic panorama and a large variety on winter(sport) activities. Further several spas are located in the Gastein valley. The conference will be held at the Kongresszentrum (congress center) which is located in the center next to the conference hotel. http://www.badhofgastein.

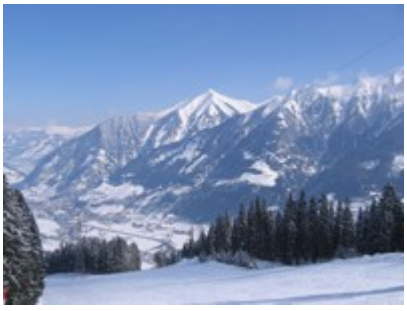
Hotel:

The conference hotel is the Kurhotel Place next to the congress center. The price per person is 500 Euro in a double room including full board for 6 nights. The registration for the school will be completed after tranfering the money to the stated bank account, as Austrian law allows hotels to charge 100% cancellation fees for hotel rooms.

http://www.kurhotelpalace.at

Travelling:

Bad Hofgastein can be reached by flying to the airports Munich/Salzburg/Linz/Vienna. There is a shuttle service that brings you to Bad Hofgastein (http://www.mietwagenservice.at). We try to arrange a special rates – please inform us where you are going to fly. Alternatively Bad Hofgastein can be reached by train from all these airports by changing train at Salzburg main station (http://www.oebb.at). In Bad Hofgastein the town center is connected to the train station by bus (distance ~ 2km – bus schedule is correlated to train schedule). Please take the bus when arriving by train to go to the city center of Bad Hofgastein where the conference venue is situated.



Dynamic response of a Ferroelectric Liquid Crystal based Mueller matrix Ellipsometer

L. M. S. Aas, M. Kildemo P.G. Ellingsen and M. Lindgren

Experimental Optics Group, Department of Physics, Norwegian University of Science and Technology (NTNU), 7491 Trondheim, Norway
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We present the design and dynamic temporal response of a Ferroelectric Liquid Crystal (FLC) based Mueller Matrix Ellipsometer (MME) operating in the Near Infra Red (NIR), designed for spectroscopy and imaging. A time dependent model, based on the measured response of the individual FLCs, is used to describe the measured temporal intensity response. With reasonable accuracy the FLC based NIR-MME system is estimated to need $16ms$ for the measurement of a complete Mueller matrix, i.e. 60 Mueller matrices per second. With less accuracy, we also demonstrate sampling of 125 Mueller matrices per second, with the measurement of the temporal Mueller matrix of a thick nematic liquid crystal during the switching between two states.

[1] L. M. Sandvik Aas, P. G. Ellingsen, M. Kildemo, F. Stabo-Eeg and M. Lindgren, The dynamic response of a near infra red Ferroelectric Liquid Crystal based Mueller matrix ellipsometer, (manuscript in preparation).
[2] L. M. Sandvik Aas, M. Kildemo, P. G. Ellingsen, F. Stabo-Eeg and M. Lindgren , Near infra red Ferroelectric Liquid Crystal based Mueller matrix ellipsometer imager: Applications to strain and bio-tissue imaging, (manuscript in preparation).

The Characterization of Thin HfO_2 Layers by In-situ Spectroscopic Ellipsometer

Ayten Canta, Gülnur Aygün

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Having high dielectric constant (κ) $\sim$ 25, hafnium oxide (HfO_2) is one of the best materials to be replaced by SiO2 [1]. Additionally the large bandgap, high refractive index, hardness and good transmission in the visible and ultraviolet range, HfO_2 is an interesting material for optical applications [2]. Spectroscopic Ellipsometry (SE) is a characterization technique used for obtaining optical constants as well as thickness of thin oxide films in the range of used light wavelength. It does not directly measure the parameters of thin oxide film, nevertheless, they can be obtained using appropriate modeling and then fitting of the measured and calculated parameters [3-4]. Depth profile of the grown film was measured during growth without giving any harm to the grown film on contrary to many other depth profile measurement techniques. (100) p-type Si wafers with the resistivity of 7-17 $\Omega - cm$ cleaned with 1% diluted HF were used as substrates. The base pressure of sputtering system was below 10^{-6} Torr. RF sputtering power used for this growth was 30 W. Prior to reactive HfO_2 film growth, a thin Hf metal was deposited onto Si substrate on purpose. Measurements with in-situ SE were made each 20 sec during the oxidation process. In this work, we mainly focused on the grown films thickness and optical constants, i.e dielectric constant and refractive index, during the film growth by analyzing the ellipsometric data measured at a fixed angle of 70o in the wavelenght range of $300 - 850nm$ using Cauchy dispersion model. During the experiment, ellipsometer measured the change in amplitude (Ψ) and phase (Δ) of polarized light upon interaction with sample. A model shown on Figure 1 was used for fitting ellipsometric measured parameters, i. e., Ψ and Δ to determine the film thickness and optical constants.

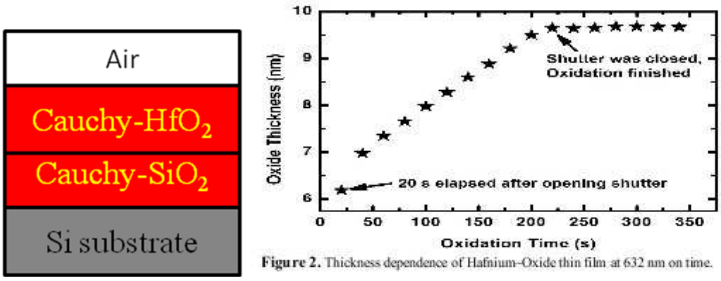

Figure 2. Thickness dependence of Hafnium-Oxide thin film at 632 nm on time.

Figure 2 shows the thickness evolution of grown hafnium oxide thin film versus time. It is clearly seen that film thickness increases after opening the shutter, i.e. active oxidation starts since the substrate was faced with reactively sputtered Hf target in O_2 and Ar environment, and come to a final stabilized thinkness in a very short time after the shutter is closed. It is obvious that thickness of HfO_2 is, as expected, directly proportional to deposition time [5]. Dielectric constant of any material is complex and given as $= \tilde{\varepsilon} = \varepsilon_1 + \imath\varepsilon_2$, where ε_1 defines the transparent while ε_2 defines the absorbed part. Since HfO_2 is transparent to the wavelength range we use, Cauchy dispersion model was used [6,7]. Figure 3 shows the variation of real part of the dielectric constant as a function of deposition time. Due to the some chemical reactions on the heated surface of film with high energy sputtered atoms continuing to occur, ε_1 value did not come to a stable level right after the deposition. So, the reduction of transparency of film was observed with increment of thickness of film.

Figure 4 shows the real part of the refractive index, n, as a function of deposition time. Measurements were repeated each 20 sec during the oxidation takes place. n was found to be in the range of 2.23 to 2.13. Its value is close to the bulk value of HfO_2 ($n = 2.1$ at $632nm$) for the thickest layer. The refractive index of sputtered film decreases as the layer number increases. The reason for this could be due to the increased void concentration in the film at the beginning of growth and it needs to be checked with any other appropriate measurement tools.

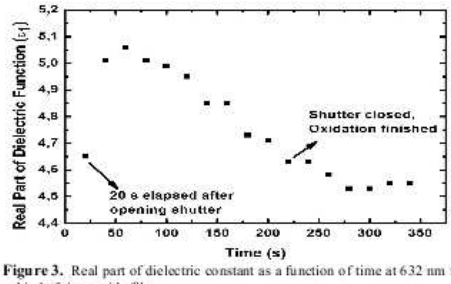

Figure 3. Real part of dielectric constant as a function of time at 632 nm for a thin hafnium oxide film.

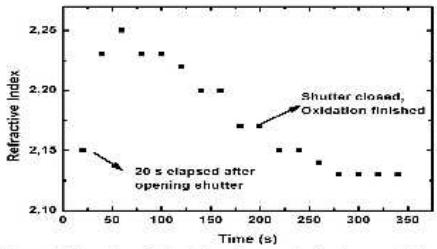

Figure 4. Change in refractive index with respect to time increment during the sputtering process. Note that 2.1 is the refractive index of bulk HfO_2 at 632 nm wavelenght.

We have demonstrated that in-situ monitoring SE technique can be successively applied and determine the optical characteristics during growth of a thin Hf-oxide film with respect to deposition time. In-situ measurements revealed a direct relation between the thickness of grown film and deposition time. We showed that dielectric constant of the grown film increases while the film gets thicker, and exhibited a decrease for refractive index at $632nm$ wavelenght with respect to layer increment. In summary, in-situ SE measurements are highly important in terms of simultaneous characterization of the grown film.

This study was supported by a TUBITAK project (# 107T117) and a BAP project (# 2008IYTE37).

[1] G. D. Wilk et al., J. Appl. Phys. 89, 5243-5275 (2000).
[2] J. Aarik et al., Thin Solid Films 466, 41 47 (2004).
[3] O. Buiu et al., Thin Solid Films 517, 453455 (2008).
[4] G.E. Jellison Jr. et al., Thin Solid Films 377-378, 68-73 (2000).
[5] M. Toledano-Luque et al., J. Appl. Phys. 102, 044106-1-8 (2007).
[6] J. M. Khoshman et al., Surface and Coatings Technology 201, 3530-3535 (2006).
[7] O. Buiu et al., Thin Solid Films 515, 623626 (2006).

Enzyme Immobilization on Plasma-Grafting Modified Sufaces

Anna Cifuentes[1], *Laia Masramon*[2] *and Salvador Borrós*[1]

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Immobilization of biological active species is crucial for the fabrication of smart bioactive surfaces. For this purpose, plasma enhanced chemical vapour deposition (PECVD) method have frequently been used to create materials with surface functional groups that can promote the anchoring of all kind of biomolecules. In this work, we have developed a novel method to covalently attach the enzyme 1,3-1,4-β-Glucanase on polystyrene surfaces of flat and spherical shapes, in order to quantify the amount of active sites generated with the PECVD technique by measuring the activity of the attached enzyme.

The polymeric substrates were previously modified with a labile pentafluorophenyl methactylate (PFM) ester group, which is of a great interest due to its high reactivity towards amino-terminated molecules, by argon plasma-grafting.. The functionalized surfaces were characterized by fluorescence assay, water contact angle measurements and Atomic Force Microscopy (AFM) analysis, showing an extremely homogeneous morphology of the active sites.

Subsequently, the synthesis and purification of the 1,3-1,4-β-Glucanase was carried out for its following immobilization on the coated surfaces. The process was monitored by the Quartz Crystal Microbalance with Dissipation (QCM-D) technology, which controls the enzyme absorption on the bioactive surface and measures the thickness of the obtained protein film. After the enzyme immobilization was determined, the activity of the substrates with the attached enzyme was tested by the DNS method.

One of the main issues is how to control the film thickness and how the film thickness affects the enzyme reactivity. For this reason, we are interested in coupling an ellipsometer to the QCM in order to control effectively the thickness influence in the interaction of the enzyme with the biological media.

Fabrication And Optical Properties Of Gold Nanowire Arrays

Christina McClatchey, John McPhillips, William Hendren, Ron Atkinson And Robert Pollard

Centre for Nanostructured Media, Queen's University Belfast

Gold nanorods with a diameter of 24nm have been grown by direct electrodeposition into thin film porous alumina. Transmission measurements showed two peaks associated with the transverse and longitudinal resonance of the nanorods. The position of the longitudinal resonant peak is highly dependent on the dimensions of the wire, spacing between the wires and the dielectric environment surrounding the wires, hence making these nanowires suitable for refractive index sensing. Changes in the resonant peak due to altering the nanowire dimensions have been monitored using transmission and attenuated total reflectance (ATR) measurements. The addition of ellipsometric measurements and models will lead to further understanding of the changes in the optical properties of the nanowire arrays as their dimensions are changed.

Fracture toughness determination of copper oxide films prepared by rF magnetron sputtering

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Thin Film Centre, School of Engineering and Science, University of the West of Scotland, PA1 2BE, Paisley, UK

Elastic modulus, indentation hardness, and fracture toughness of copper oxide films prepared by magnetron sputtering at various rf power and oxygen flow rates were investigated. A Hysitron Triboscope Nanomechanical system was used to obtain force-displacement curves for the samples at various loads, to determine the indentation hardness and elastic modulus of the films. Vickers indentations were performed with a Shimadzu Macro Hardness indenter to produce cracks at corresponding loads. The Vickers diagonals and crack lengths were used to calculate the fracture toughness of the oxide films. Optical properties of the films were also investigated. The fracture toughness measurement reveals films of brittle nature, while the optical properties of the films suggest that they may have potential applications in coatings for solar control on windows.

A Study Of Poly (methyl Methacrylate) Thin Films Using Spectroscopic Ellipsometry

Khawla Owedat, Husam M. El-nasser

Al al-Bayt University

Polymethylmethacrylate (PMMA) thin films were prepared from PMMA and toluene solutions by spin coating method on glass substrates. Spectroscopic and structural measurements were characterized using the variable angle spectroscopic ellipsometry (VASE), IR spectroscopy and SEM imaging. Ellipsometric data were taken over the spectral range of UV-Visible-Near infrared of $200 - 1000nm$ at different angles of incidence.

PMMA thin films were modeled using Cauchy model. A Bruggmann effective medium approximation layer was employed with two constitutions PMMA and voids to present the relatively thicker films. The index of refraction and extinction index were studied.

[1] Al Attar H. A., Taqatqa O., J. Opt. A: Pure Appl. Opt., 5, S 487 (2003).
[2] Walsh C. B., Franses E. I, Thin Solid Films, 134, 263 (1999) .

Spectroscopic Ellipsometry Studies of Co/Cu Multilayers

F. Haidu[1], *O. D. Gordan*[1], *D. Makarov*[2], *M. Albrecht*[2], *C. Cobet*[3], *N. Esser*[3] *and D. R. T. Zahn*[1]

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[2] *Surface and Interface Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany*
[3] *ISAS Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany*

Determination of dielectric functions of thin metal films is of great fundamental importance and technological relevance. However, optical studies of metallic layers are particularly difficult due to the lack of transparent range and low penetration depth. Moreover, the optical properties of metallic ultra-thin films can be quite different when compared to the bulk. In this work the variation of the dielectric function of Co/Cu multilayered films is compared to individual layers of Cu and Co with various thicknesses on Hydrogen passivated Silicon (H-Si). The measurements were performed in the energy range from 0.7 to $5eV$ using a commercial ellipsometer. Additionally, the range was extended up to $10eV$ with the Vacuum Ultra-Violet ellipsometer setup at Bessy II, Berlin. A model was developed in order to simulate the optical response of the films and the multilayers.

Determination of anisotropic optical constants of chiral polyfluorene using Ellipsometry

Girish Lakhwani, R.A.J. Janssen, S.C.J. Meskers

Technische Universiteit Eindhoven, The Netherlands

Polyfluorene (PF) polymer has a backbone consisting of alternating single and double bonds, which gives the polymer semiconducting properties (blue light emitting LEDs). Polyfluorene is interesting because it occurs in different crystalline, liquid crystalline (LC) and (semi-)crystalline states each with its own optoelectronic properties. Processing conditions have a strong influence on the conformational and crystallization states in thin films deposited via e.g. spincoating.

Here we investigate various organizations/aggregation states within the film of *chiral* polyfluorene **1** (poly9,9-bis [(3S)-3,7-dimethyloctyl]-2,7-fluorene. From spectroscopic ellipsometry, we obtain anisotropic optical constants of the polymer film. We observe that the films are uniaxial with the unique optic axis normal to the surface. The absorption coefficient in the wavelength region corresponding to the transition from the ground state (S_0) to the lowest excited singlet state (S_1), for the light with $\vec{E}$ in the direction of the normal ($k_\perp$) is found to be 2 times less than for light with $\vec{E}$ in the plane of the film ($k_{||}$).The transition dipole moment for the optical transition ($S_0 \rightarrow S_1$) lies parallel to the backbone of the polymer chain. The observed anisotropy indicates that the chains are preferentially oriented in an in-plane direction.

Near-field Enhancement Of Si Qds Photoluminescence By Ag Nps In A Totally Integrated Configuration

Reyes-esqueda, Benami, Torres, Bornicelli,fernandez,palacios,lpez,cheang,crespo,rodrguez,oliver

Instituto de Fisica, UNAM

Si and Ag high-energy ions were implanted in a high-purity silica matrix. After proper thermal treatments, embedded layers of Si and Ag nanoparticles into the silica matrix were obtained. By controlling the implantation energy of the Ag ions, the distance between both layers of nanoparticles was varied, passing from a near-field enhancement to a total quenching of the photoluminescence exhibited by the Si nanoparticles. Preliminary results for the near-field enhancement of the nonlinear response of the Si nanoparticles will be also presented.

In Situ Investigation of CuPc Thin Films Grown on Vicinal Si(111)

Li Ding, Marion Friedrich, Ovidiu Gordan and Dietrich R. T. Zahn

Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

Spectroscopic ellipsometry (SE) [1] and reflection anisotropy spectroscopy (RAS) [2] are known to be surface sensitive and non-destructive techniques. SE is widely used to determine the dielectric functions, from which the out-of-plane anisotropy of thin films can be deduced. RAS has the capability to detect the very tiny in-plane anisotropy in the order of 10^{-3}. Vicinal Si(111) surfaces are interesting due to their surface anisotropy [3]. Here we employ SE and RAS simultaneously to monitor in real time the growth process of CuPc thin films on hydrogenated vicinal Si(111). The films were grown by organic molecular beam deposition (OMBD). The RAS features of CuPc are found to be linearly dependent on the film thickness in the range of $30nm$, indicating a strong influence of the surface steps on the in-plane molecular alignment in the film. This phenomenon could be linked with the formation of crystal structures in the thicker film. The change in out-of-plane molecular orientation is discussed from the in situ SE spectra.

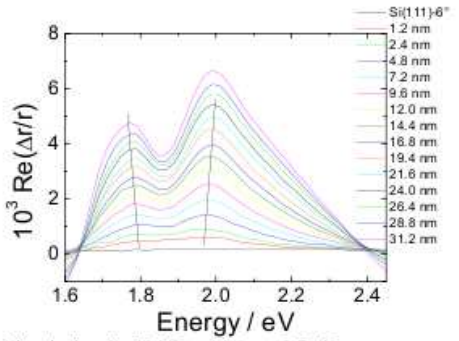

Fig. 1. *In situ* RAS spectra of CuPc on Si(111)-6°.

[1] G. Bauer and W. Richter, Optical Characterization of Epitaxial Semiconductor Layers, Springer, Berlin, 1996

[2] P. Weightman, D. S. Martin, R. J. Cole, and T. Farrell, Rep. Prog. Phys. 68, 1251 (2005).

[3] T. Yasuda, D.E. Aspnes, D. R. Lee, C. H. Bjorkman, and G. Lucovsky, J. Vac. Sci. Technol. A 12(4), 1152 (1994).

Spectroscopic Ellipsometry Study of Gold Island Films

Martin Loncaric, Jordi Sancho-Parramon, Hrvoje Zorc

Rudjer Boskovic Institute, Bijenicka cesta 54, 10000 Zagreb, Croatia

Metal island films can be considered as two-dimensional ensembles of metal clusters and one of the most easy-to-prepare cases of nanostructured matter, as they can be obtained during the first stage of evaporation process. These films show unique optical properties, owing to the local surface plasmon (SP) resonance of the free electrons in the clusters. The SP properties can be easily tailored using different methods, like coating of metal island films with a dielectric layer or the modification of deposition conditions. In the present work we study the optical and structural properties of gold metal island films deposited on glass substrates with different mass thicknesses at different substrate temperatures. The characterization is performed by spectroscopic ellipsometry and atomic force microscopy. The results enable establishing the correlation between the SP absorption properties with the size and shape of the formed gold islands.

Exciton states in quasi-1d Mott-Hubbard insulator LiCuVO4

Yulia Matiks, Peter Horsch, Reinhard Kremer, Bernhard Keimer, Alexander Boris

Max-Planck-Institut fr Festkrperforschung Heisenberg str. 1, 70569 Stuttgart, Germany

The spectroscopic ellipsometry has been used to investigate the low-lying electronic excitations in the strongly correlated spin-chain copper oxide LiCuVO4 in the range $0.75 - 6.5eV$ in temperature interval $7 - 300K$. We have observed strong anisotropy associated with p-d transitions. To derive the principal components of the dielectric tensor from ellipsometric data, measured for orientation of sample $(0°, 0°, 0°), (90°, 0°, 0°)$ and $(90°, 90°, 0°)$, a numerical regression procedure was applied. The anisotropic model was constructed on base of biaxial material. The integrated optical conductivity for polarization along the chains confirms the redistribution of the spectral weight between $3.5 - 4.4eV$ range and a weak two-peaks structure centered at 2.15 and $2.95eV$ below $80K$. Temperature dependence of these two bands identified in the dielectric response along the chains follows spin correlations within the chains that make them apparent at $7K$ but strongly suppressed and invisible at $300K$. We identify these two bands as exciton states associated with the upper Hubbard band that emerge at $U - V$ and $U - V/2$ as a consequence of the long-range Coulomb interaction $Vm = V/m(U \sim 3.75, V \sim 1.8eV)$. We show that the exciton absorptions provide a tool to measure the nearest and next-nearest neighbor spin correlations of the underlying frustrated $J_1 - J_2$ spin chain and their temperature dependence.

Ellipsometry Of Gold Nanoparticles On A Surface

E.Bortchagovsky, A.Dejneka, V.Lozovski, T. Ishakova

Taras Shevchenko National University of Kyiv

Gold nanoparticles thermally evaporated on a glass substrate were investigated by spectroscopic ellipsometry. Measurements at different angles of incidence were made both on fresh structures and on annealed ones depending on the mass thickness of the film. It is shown that the standard models of the effective medium approximation are not able to reproduce measured spectra. Data treatment with the account of the interparticle interaction gives better results.

Biaxial optical anisotropy of self aligned Silver nanoparticles and nanowires

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In the present study ion beam sputtering has been used for pre-structuring of a silicon substrate followed deposition of metal by e-beam evaporation. First a low energy ion beam (Ar+, $500eV$) is incident on the substrate surface at an angle of 67° to the surface normal to produce well ordered ($20-50nm$, Figure 1a) ripple patterns. Then physically vaporized Ag atoms are deposited at grazing angle of 70° to the surface normal and normal to the ripples direction. Varying deposition parameters, i.e. ripple periodicity, substrate temperature and atomic flux, we were able to produce well ordered nanoparticles and nanowires. A very high degree of alignment not reported so far using the present technique has been achieved (Figure 1b and 1c). Self-aligned Ag nanoparticles and nanowires deposited on pre-patterned ripple surfaces exhibit strong optical anisotropy. Generalised ellipsometry measurements show that off diagonal Jones matrix elements ($\Psi_{ps}, \Delta_{ps}, \Psi_{sp}, \Delta_{sp}$) are non zero and vary with Eulers angle ϕ. This indicates that such a medium is biaxial in nature. Therefore, to extract the three dimensional dielectric functions a biaxial layer model approach is used with the help of WVASE32 software. Two Lorentz oscillators are used along x and y direction independently and Drude model along z-direction for nanoparticles. This approach provides a very good fitting with the measured Jones matrix element $\Psi_{pp}, \Delta_{pp}, \Psi_{ps}, \Delta_{ps}, \Psi_{sp}, \Delta_{sp}$. Different cases for ordered nanoparticles and wires will be presented. Maximum anisotropy was observed when the optical axis is at 45° with respect to the lab coordinates.

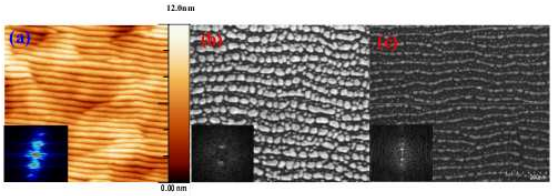

Figure 1: Figure (a), (b) and (c) are the AFM and SEM images of pre-rippled Si templates, aligned Ag nanoparticles and nanowires respectively with a periodicity of 32.0 nm. Inset show the FFT of the images.

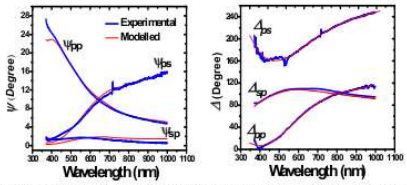

Figure 2 : Anisotropy elements (blue line) appear during the measurements of sample shown in figure 1 (b), using the generalized ellipsometry in anisotropic mode measurement. Measurement performed at 75° incidence angle and substrate at 45° with respect to plane of incidence. Red line shows the modelled values of anisotropic components.

[1] A. Keller, S. Facsko, and W. Moller, New Journal of Physics 10 (2008) 063004.
[2] T.W.H. Oates, A. Keller, S. Facsko , A. Mücklich , Plasmonics 2 (2007) 47.

Synthesis of $1-d$, $2-d$, $3-d$ structures based on fullerenes on the surface of semiconductors

O.V.Naboka

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Evaporating of drops on the solid surfaces is a very promising approach for obtaining of organized structures from solutions. Particularly this technique could be used for surface modification by fullerenes, self-assembly and separating of nanomaterials.

Various ensembles could be formed during precipitation of dissolved substances on the gas-liquid-solid interface by regulating of solutions composition and rate of solvent removal and selecting of substrates with different surface energy and functional groups.

It has been established in our work that assemblies of fullerene crystals which differ by morphology, composition and structure could be controllably obtained through changing of nature of substrate surface and mode of solvent evaporating. Fullerene and fullerenelike cluster assemblies that consisted of crystals of various size (on the surface of Al $5\mu m$, glass $8\mu m$, polytetrafluoroethylene $80\mu m$, GaAs $0,3\mu m$) have been obtained by us. That is important for obtaining of functional composites, coatings and synthesis of new nanostructured carbon materials.

Photoelectrochemical processes on the surfaces of GaAs-electrodes modified with pure fullerene C60 and mixtures of fullerenes (extracted from fullerene-containing soot) by deposition from drops of their solutions were studied during our research. It was established that efficiency of conversion of solar energy into the chemical energy of hydrogen attained after modifying of GaAs-surface with fullerenes was almost the same as after modifying of GaAs-surface with Pt and Zn. Increase of photosensitivity of GaAS after surface modification connected with decrease of rate of surface recombination of charge carriers.

For application of $1-d, 2-d, 3-d$ structures based on fullerenes further researches such as ellipsometry and complex physico-chemical techniques need to be conducted.

Real-time in-situ observation of growing nanostructures by spectroscopic ellipsometry

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Self organized nanostructures open up for efficient and low-cost production of materials with new and interesting properties, with applications in electronics, optics and life sciences. A major challenge for controlling and understanding growth processes of such structures is the characterization of nanometer sized structures. Traditional near field techniques such as atomic force microscopy, scanning electron microscopy and transmission electron microscopy, are time consuming and not suited for in-situ use. A fast vacuum suited observation technique is necessary for studies of growth laws and their dependence on formation conditions. We demonstrate that in-situ spectroscopic ellipsometry can be used to measure the height evolution of growing nanostructures during low energy ion sputtering of GaSb. A graded anisotropic effective medium approximation is used to extract the mean height of the structure from the optical measurements. The in-situ observations give new physical insight into the formation process of such structures. Two different growth regimes have been observed, first exponential, and then linear. The linear regime was not expected by traditional sputtering theories, but can possibly be explained by Ga segregation.

Disorder enhances thermoelectric figure of merit in armchair graphane nanoribbons

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We study the thermoelectric property of graphane strips by using density functional theory calculations combined with the nonequilibrium Green's function method. It is found that figure of merit (ZT) can be remarkably enhanced five times by randomly introducing hydrogen vacancies to the graphene nanoribon derivatives - armchair graphane nanoribbons. For $5nm$ wide ribbons under certain conditions ZT can be as high as 5.8 and depends on temperature linearly. The high ZT, low cost and rapid advances in the synthesis of nanoscale graphene derivatives make carbon-based materials a viable choice for thermoelectric applications.

Reflection Anisotropy Spectra simulations of mechanically strained silicon

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Particular Si(111) and Si(100) wafers are in-plane isotropic if no stress is applied, thus the Reflection Anisotropy caused by mechanically induced strain can be measured directly [1,2,3]. The real and imaginary part of the Reflection Anisotropy Spectroscopy (RAS) transform into the well known y and D values obtained from Spectroscopic Ellipsometry (SE). Therefore it is possible to model RA spectra using commercial SE evaluation software. A detailed comparison of the simulations and the experimentally measured RAS is given. Additionally the strain was calculated and correlated with RAS simulations.

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Ellipsometric Characterization Of Alinn Thick Films Grown By Movpe

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Knowing the refractive index and absorption coefficient of III-nitride materials is a critical factor in designing optoelectronic devices. High quality AlInN thick films with various In concentration were grown by metalorganic vapor phase epitaxy on sapphire substrates. The effect of AlInN composition on the optical constants was determined within the transparent wavelength region by spectroscopic ellipsometry. The results for the optical parameters are in good agreement with the theoretical predictions.

Protection of Sensors for Biological Applications by Photoinitiated Chemical Vapor Deposition of Hydrogel Thin Films

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The photoinitiated chemical vapor deposition (piCVD) of ultrathin pHEMA poly(hydroxyethyl methacrylate) films with tunable cross-link density is presented. pHEMA has been used extensively in biological and biomedical applications, and its biocompatibility, including resistance to protein adhesion, has been investigated. When synthesized as a cross-linked network, pHEMA films have small mesh sizes that prevent the permeation of large biomolecules. In this work, the polymerization is initiated by exposing monomer vapors under moderate vacuum to low power density ultraviolet light. This method is similar to iCVD, a dry process that has been used to synthesize a variety of polymers as thin films. No solvent or plasma is used, the polymerization occurs near room temperature ($20 - 40°C$), and the hydrogel can be synthesized on virtually any surface. A laser interferometer ($633nm$ He-Ne laser source JDS Uniphase) allowed for real time tracking of the deposited film thickness and termination of growth at the desired film thickness. The films synthesized are cross-linked during the deposition, and the cross-link density allows for the passage of water and small molecule analytes, while preventing the transport of macromolecules such as proteins. The films are stable in aqueous media and more resistant to nonspecific protein adhesion than bare silicon. To function as a protective overlayer for biosensor, a thin film must allow for the passage of small analytes from the medium to the sensor. It is therefore critical that the film swell when in contact with a biological medium while remaining adhered to the sensor substrate. All the films synthesized in this study exhibited a rapid, reversible swelling response while maintaining adhesion to the substrate. As characterized by in situ spectroscopic ellipsometry, the films reached their equilibrium swollen water content within 5 min of submersion in pH 7.4 buffer solution. Upon rinsing in deionized water and drying under vacuum, the films returned to their original thickness. When submerged again, the films rapidly returned to their swollen state.

Modification Of The Effective Optical Properties Of Polymer Films By Dispersion Of Gold Nanoparticles

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Last years have seen many works dealing with meta-materials made by lithography. Nevertheless this technique is only available to make two-dimensional materials and thus doesn't allow to reach the principal applications of metamaterials which require three-dimensional devices: hyperlens, invisible cloak, etc. To try to resolve this issue, theoreticians have done new proposals for meta-materials. Some of them are based on nanoparticles. Obtaining a material with controlled permittivity by making a thin film of polymer which include a sufficient volume fraction of nanoparticles to reach a negative effective permittivity.