Fundamentals and Applications of Nanophotonics, Photovoltaics and Bio-Photonics

March 7th(Thu) & 8th(Fri), 2013
MAScIR, Rabat, Morocco
(http://parc.osaka-u.ac.jp/asiaphotonics/morocco)

Organized by
Moroccan Foundation for Science & Innovation & Research (MAScIR),
Optics & Photonics Center, Rabat, Morocco, and
Photonics Center Osaka University, Japan

Funded by
JSPS Asian Core Program, MEXT and MAScIR

Organizers | Optics & Photonics Center, MAScIR; Photonics Center, Osaka University

Sponsors | Hamamatsu Photonics K. K.

Contact: | **Optics & Photonics Center, MAScIR, Madinat El Irfane, 10100 Rabat, Morocco**

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Workshop Program

Thursday, March 7, 2013

09:00 - 10:00 Opening ceremony (chaired by Z. Sekkat, Rabat, Morocco)

10:00 - 11:00 Keynote talks
Session Chair: P. Verma (Osaka University, Osaka, Japan)

10:00 - 10:30 S. Kawata (Osaka University, Osaka, Japan)
Title: "*Photonics Research in Osaka*"

10:30 - 11:00 Z. Sekkat (MAScIR-Photonics and University Mohammed V-Agdal, Rabat)
Title: "*Photonics Research in Rabat*"

11:00 - 11:30 Coffee Break with Poster Session

11:30 - 12:45 Invited Talks 1
Session Chair: S. Kawata (Osaka University, Osaka, Japan)

11:30 - 11:55 P. Verma (Osaka University, Osaka, Japan)
Title: "*Plasmonics for nanospectroscopy and nanoimaging*"

11:55 - 12:20 M. Maaza (Nanosciences Labs., National Research Foundation of South Africa)
Title: "*Multifunctional Photonics Properties of VO_2 Based Nanostructures*"

12:20 - 12:45 S. Hayashi (Kobe University, Kobe, Japan)
Title: "*Anisotropic Propagation of Surface Plasmon Polaritons*"

13:00 - 14:30 Lunch break

14:30 - 16:10 Invited Talks 2
Session Chair: S. Hayashi (Kobe University, Kobe, Japan)

14:30 - 14:55 Y. Inouye (Osaka University, Osaka, Japan)
Title: "*Fluorescence platinum nanoclusters: synthesis and characterization*"

14:55 - 15:20 N. Azami (Institut National des Postes et Télécommunications, Rabat, Morocco)
Title: "*All Fiber devices for sensors and telecommunications applications*"

15:20 - 15:45 M. Ozaki (Osaka University, Osaka, Japan)
Title: "*Solution Processable Phthalocyanine-based Solar Cell with High Performance*"

15:45 - 16:10 M. Abdelfdil (Faculty of Sciences, University Mohammed V-Agdal, Rabat, Morocco)
Title: "*Transparent conducting oxide thin films for solar cells*"

16:10 - 16:40 Coffee Break with Poster Session

16:40 - 18:15 Round table discussion (with committee members)

18:15 - Banquet

Friday, March 8, 2013

09:00 - 10:40 Session 3

Session Chair: Y. Inouye (Osaka University, Osaka, Japan)

09:00 - 09:25 Chi-Kuang Sun (Molecular Imaging Center, National Taiwan University, Taipei, Taiwan)
Title: "*All-Optical Contact-Free Probing of Solid/Liquid-Water Interface by Nanoultrasonics with Sub-Nanometer Resolution*"

09:25 - 09:50 A. Benyoussef (MAScIR-Materials, & Faculty of Sciences, University Mohammed V-Agdal, Rabat)
Title: "*Magnetic and electronic properties of new half-metals*"

9:50 - 10:15 K. Kitano (Osaka University, Osaka, Japan)
Title: "*Novel applications of atmospheric pressure plasmas with room temperature to medicine and biomaterial*"

10:15 – 10:40 A. Maaroufi (Faculty of Sciences, University Mohammed V-Agdal, Rabat)
Title: "*Thermoelectric Properties of Phosphate Glasses/Metal Composites*"

10:40 - 11:00 Closing Remarks (by Z. Sekkat, Rabat, Morocco)

11:00 - 11:30 Coffee Break

11:30 - 13:00 Lab visits

13:00 - 14:30 Lunch Break

14:30 – Excursion (optional)

List of Poster Presentations

1. **Laser Induced Micro-Nano Structures on Metallic Thin Films**

Saif-ur Rehman[1-2], Lebogang Kotsedi[4], Malik Maaza[4] and Zouheir Sekkat[1-3]

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[3]*Hassan II Academy of Science and Technology, Rabat, Morocco*
[4]*Nanosciences Laboratories, Materials Research Division, iThemba LABS, National Research Foundation of South Africa*

2. **Enhancement and Control of Fluorescence Emission of Molecules in a Nanoaperture with Plasmonic Corrugations**

O. Mahboub[2], H. Aouani[1], N. Bonod[1], E. Devaux[2], E. Popov[1], H. Rigneault[1], T. W. Ebbesen[2], J. Wenger[1]

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[2]*Institut de Science et d'Ingénierie Supramoléculaires, Université de Strasbourg, CNRS, 8 allée G. Monge, 67000 Strasbourg, France*

3. **On the resolution of sensors based on optical resonances**

Dmitry V. Nesterenko and Zouheir Sekkat

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4. **Plasmonics at Metallic Thin Layers**

Saif-ur Rehman[1-2], Anouar Rahmouni[1], Tarik Mahfoud[1], Dmitry Nesterenko[1], and Zouheir SEKKAT[1-3]

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5. **Elaboration and Characterization of ZnO Doped by Al as Thin Transparent Oxides for Photovoltaic Applications**

Z. Laghfour[1,2] , T. Ajjamouri[1,2],K. Nouneh[1], M. Abd-Lefdil[2] and Zouheir SEKKAT[1-3]

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6. **Synthesis of Arrayed ZnO nanorods by Wet Chemical Method for Photovoltaic Applications**

T. Ajjamouri[1,2],K. Nouneh[1], Z. Laghfour[1], A. Maaroufi [2] and Zouheir SEKKAT[1-3]

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7. **Electronic Structure and Optical Properties of Fe, Mn, V, Co, Ni and Cr doped GaN and ZnO**

O.Mounkachi[1], M. Hamedoun[2], A. Benyoussef[1,2], E. Salmani[2] and H. Ez-Zahraouy[2]

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[2]*LMPHE (URAC 12), Departement de Physique, Faculté des Sciences, Université Mohammed V-Agdal, Rabat, Morocco*

8. **Optical properties of ZnTe doped with transition metals (Cr, Mn and Ti)**

H. Zaari[1], M. Boujnah[1], A. El Hachimi[1], A. Benyoussef[1, 2,3] and A. El Kenz[1,*]

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9. **XMCD studies and magnetic properties of ZnTe doped with Mn, Cr, Ti and Co**

H. Zaari[1], M. Boujnah[1], A. El Hachimi[1], A. Benyoussef[1, 2,3] A. El Kenz[1,*]

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10. **Comparative Thermal Degradation Kinetics of Electrically Insulating/Conducting epoxy/Al Composites Under Dynamic Conditions**

M. Azeem Arshad[1], A. Maaroufi[1], R. Benavente[2], J. M. Pereña[2], G. Pinto[3]

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11. **Conducting-non conducting phase transition, with PTC effect in new epoxy/metallic fillers Composites**

N. Boumedienne[a], Y. Faska[a], A.Maaroufi[a,], G. Pinto[b], M. Ouchetto[c], R. Benavente[d], J. M. Pereña[d]

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12. **Non-Linear Electronic Conductivity of Zinc Phosphate Glasses/Metal Composites**

O. Oabi[a], M. Hammi[a], Maaroufi[a,], G. Pinto[b], M. Ouchetto[c], R. Benavente[d], J. M. Pereña[d]

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13. **Synthesis and Fluorescence Spectral Behaviors of New Quinoxaline Derivatives**

Hicham Gueddar[a,b], Rachid Bouhfid[a], El Mokhtar Essassi[a,b]

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14. **Chemical and geochemical characteristic of bituminous rocks of the Moroccan Rif**

Khalihena Groune, Mohammed Halim

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Equipe de Physico-Chimie des Matériaux, Catalyse et Environnement
Université Mohammed V, Faculté des Sciences, Avenue Ibn Batouta BP.1014, Rabat Agdal, Maroc

15. Non-isothermal kinetic study of the thermal decomposition of DiCalcium Phosphate Dihydrate $CaHPO_4$, $2H_2O$ (DCPD)

Adnane EL HAMIDI, Said ARSALANE, Abdellah EL MANSOUR and Mohammed HALIM

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16. Photovoltaic Panels Tilt Angle Optimization -Case Study for Ifrane, Morocco

Driss Lahjouji, Hassane Darhmaoui

School of Science and Engineering, Al Akhawayn University, Ifrane, Morocco

17. Photo-Induced Electron Spin Resonance Phenomena in α-Cr_2O_3 Nanoparticles

S. Khamlich[1-2], V. V. Srinivasu[1-2], A. Konkin[1,3], R. McCrindle[1-2], N. Cingo[1,4] and M. Maaza[1-2]

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18. Z-Scan & Optical Limiting Properties of Natural Hibiscus Sabdarifa Dye

A. Diallo[1-2], S. Zongo[1-2], P. Mthunzi[1-2,3], W. Soboyejo[1-2,4], Z. Sekkat[1-2], M. Maaza[1-2]

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19. Optical Limiting in Femtosecond Mott Transition Vo_2 Nanophotonics

L. Mathevula[1-2], A. Simo[1-2], P. Mthunzi[1-2,3], T. Kerdja[1-2,4], A. Chaudhary[1-2,5], Z. Sekkat[1-2], M. Maaza[1-2]

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20. Anderson Localization In Ship-Shaped CNTs

Th. Mhlungu[1-2], A.C. Beye[1-2], N. Cingo[1-3], A. Govindaraj[1,4] , C.N.R. Rao[1,4] and M. Maaza[1-2]

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Abstracts for Oral Presentations

Photonics Research in Osaka

Satoshi Kawata

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Photonics is attracting increasing attention as one of the key technologies that will underpin the science, industry, and society of the 21st century following in the footsteps of 20th century electronics. Unlike an electron, which is a charged particle, a photon is a gentle messenger and probe that can travel freely through air, water, and even the human body. From the history of Japan, Osaka has been known as the city of light and Osaka University has provided the key photonics research in the world, having hosted a number of photonics research projects with many of its faculties and schools conducting research and education from basic to applied levels and thereby producing numerous talented scientists and engineers. A historical hub for photonics research in Japan, Osaka University presently is home to the greatest number of optical researchers in the country, who represent the entire spectrum of subfields, including spectroscopy, photochemistry, bio-optics, and more.

From 2001 to 2006, Osaka University pursued the "Frontier Research Institute", a program for "Fostering Strategic Centers of Excellence under the Special Coordination Funds for Promoting Science and Technology", in which a nanophotonics project was selected as one of the priority areas. Under the framework of this program, aggressive efforts were made to establish photonics as an academic discipline and interconnect it with other disciplines, and also to promote industry-academia collaboration through, for example, joint research via matching funds with various businesses. It was in the spirit of such endeavors that in 2005 the "Nano-Photonics Initiative" was formed as an independent multidisciplinary research institution. As a follow-up to this pioneering project, in July 2007 the University established the Photonics Advanced Research Center (PARC), one of the programs for the "Creation of Innovation Centers for Advanced Interdisciplinary Research Areas" that are financed through Special Coordination Funds for Promoting Science and Technology. This research institution has since committed itself to the advancement of nanophotonics research, creation of new industries, and human resources development through a variety of initiatives.

One of the significant activities of PARC at Osaka University is the joint research programs, currently running with universities in China and Taiwan, where the foremost emphasis is on the exchange of students and researchers between theses universities and Osaka University. New such joint research plans are on the way, one of which is a possible collaboration between Morocco and Japan. The present Workshop is an important step forward in this direction.

Photonics Research in Rabat

Zouheir Sekkat

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Abstract

Photonics research in Morocco started as collaboration with Japan in 1999. Several topics were studied including photonic polymers containing photoisomerizable nonlinear optical chromophores, and two-photon absorption, as well as near-field nano-optics. Morocco has now an optics and photonics research center, MAScIR-Photonics, twinned with the photonics advanced research center (PARC) of Osaka University, targeting research in strategic area for Morocco including energy and health. MAScIR-Photonics is a node in the African Laser Center together with the National Laser Center of South Africa. MAScIR-Photonics has a platform of photonics technology and simulations upon which actual projects are built such as thin film photovoltaics an bio-photonics. In this presentation, I will discuss some of the topics we are actually conducting, such as plasmonics, and inorganic photovoltaics. An evanescent wave may exist at the surface of a metal film, as a kind of slow light which is associated with the collective oscillation of the free electrons of the metal, also called surface plasmon polaritons (SPPs). I will discuss about the mechanism and functionality of surface plasmons, including wavelength shortening and applicability in bio-sensing and photovoltaics. I will discuss in particular, Ultra-violet (UV) SPPs at Aluminum layers as well as the spectral response of sensing configurations of different metal layers. Some results on Zinc Oxide thin films and nanostructures for photovoltaics will also be discussed.

References

1. T. Mahfoud, Z. Sekkat, et al. «High quality nano-patterned thin films of the coordination compound {Fe(pyrazine)[Pt(CN)(4)]} deposited layer-by-layer» New Journal of Chemistry 35 (10) 2011.
2. D.V. Nesterenko, S. Rehman, and Z. Sekkat "Surface plasmon sensing with different metals in single and double layer configurations", Applied Optics 27 (51), 6673, (2012).
3. A. Douayar, P. Prieto, G. Schmerber, K. Nouneh, R. Diaz, I. Chaki, S. Colis, A. El Fakir, N. Hassanain, A. Belayachi, Z. Sekkat, A. Slaoui, A. Dinia and M. Abd-Lefdil "Investigation of the structural, optical and electrical properties of Nd-doped ZnO thin films deposited by spray pyrolysis", The European Physical Journal Applied Physics, 61 (01) 10304 (2013).

Plasmonics for nanospectroscopy and nanoimaging

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Visible light carries an energy that is comparable to the electronic energies of most of the naturally existing materials. Thus, visible light can interact directly with the electronic system of a sample and fetch rich information about the intrinsic properties of the sample. Optical microscopy has therefore always been a convenient tool for analyzing and imaging various materials. However, the spatial resolution in optical microscopy is restricted by the diffraction limit of the probing light, making it impossible to analyze materials smaller than about half of the wavelength. This restriction can be overcome if a conventional optical microscopic technique, such as Raman microscopy, is combined with the near-field techniques. Tip-enhanced Raman scattering (TERS), which is based on plasmonic enhancement and confinement of light field near the apex a sharp metallic nanotip, is such a technique that facilitates characterization and imaging of a sample at nanoscale. This plasmonics-based technique allows us to have a spatial resolution down to about 15 nm in optical nanoimaging [1,2].

Apart from obtaining simple images of nano-sized samples, one can also visualize variations in various physical and chemical properties within the sample through their spectroscopic signatures at nanoscale. For example, we can image the variation of strain developed along the length of an isolated carbon nanotube at high spatial resolution better than 20 nm.

In addition to the contributions from plasmonic confinement of light, mechanisms beyond plasmonics can further improve the imaging quality tremendously. One of such examples is the inclusion of tip-applied pressure in TERS, which distorts the sample locally. Owing to the sharp curvature of the tip apex, the contact area between the tip and the sample can be extremely small, ideally of molecular level. By optically sensing this localized distortion, one can obtain super high resolution. In recent studies, resolution better than 4 nm was demonstrated though this imaging technique [3].

Furthermore, by controlling the distance between the tip and the sample with a precision of sub-nanometer scale, one can distinguish three different kinds of interactions between the tip and the sample, namely the plasmonic, the chemical and the mechanical interactions. This gives further strength to TERS in analyzing samples at extremely high spatial resolution.

[1] S. Kawata, Y. Inouye, and P. Verma, *Nature Photon.* **3**, 388 (2009).
[2] P. Verma, T. Ichimura, T. Yano, Y. Saito, and S. Kawata, *Laser & Photonics Rev.* **4**, 548 (2010).
[3] T. Yano, P. Verma, Y. Saito, T. Ichimura, and S. Kawata, *Nature Photon.* **3**, 473 (2009).

Multi-Functional Photonics Properties Of VO_2 Based Nanostructures

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Keywords:
Vanadium dioxide, phase transition, refractive index modulation, infrared, Plasmon tunability, smart windows, nano-plasmonics, ultrafast transition, femtosecond regime.

Abstract
Being a Mott type oxide, at a temperature of 68°C and ambient pressure, stoichiometric VO_2 undergoes a first order metal-insulator transition, which is accompanied by a structural transition from a high-temperature rutile phase to a low-temperature monoclinic phase [1]. The latter result causes an abrupt change in the resistivity over several orders of magnitude induced by the band gap opening. From optical point of view, this metal-insulator transition is accompanied by a significant and reversible variation of the refractive index under a thermal or laser stimuli. Hence, VO_2 based coatings have been attracting considerable interest for fundamental reasons, and certainly for technological applications in the solar energy sector and ultrafast linear and nonlinear photonics. In this contribution, the photonic multi-functionality of nano-structured VO_2 based coatings are presented. This includes applications such as smart windows applications, thermal sensors, optical switching devices, field effect transistors and electro-optical gates as well as ultrafast tunable nano-plasmonics and optical limiting optoelectronic devices among others [1-9].

References

1. *N.F. Mott, Rev. Mod. Phys. 40, 677 (1968), and references therein.*
2. *C. Sella, M. Maaza, O. Nemraoui and J. Lafait, Surface & Coating Tech.. 98, (1998) 1477.*
3. *S.Chen, H.Ma, X.Yi, H.Wang, X.Tao, X.Li, C.Ke, Infrared Phys. & Tech. 45, (2004) 239.*
4. *I. Balberbg, S. Trokman, J. Appl. Phys. 4, (1975) 2111*
5. *M. Maaza, C. Sella , B. Barak, N. Ouassini, A.Beye, Optics Comms., 254 (2005) 188.*
6. *S.B. Wang, B.F. Xiong, S.B. Zhou, G. Huang, S.H. Chen, X.J. Yi, Sensors and Actuators A 117 (2005) 110–114.*
7. *M. Maaza, D. Hamidi, A. Simo. T. Kerdja, and A.K. Chaudhary, Optics Comms., 285 (2012) 1190.*
8. *M. Maaza, N. Ouassini, C. Sella & A.C.Beye, Gold Bulletin.38 (2005)3.,*
9. *M. Maaza, K. Bouziane & J. Maritz, Optical Materials.15 (2000) 41.*

Anisotropic Propagation of Surface Plasmon Polaritons

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Surface plasmon polaritons (SPPs) are known to be transverse-magnetic (TM) waves propagating at metal-dielectric interfaces and can be excited only by *p*-polarized light. Physical properties associated with SPPs in ordinary systems are independent of the direction of propagation. However, when the dielectric adjacent to the metal is optically anisotropic, the anisotropy in the properties of SPPs is induced and expected to find potential applications in plasmonics and nanophotonics.

In the first part of this presentation, our recent experimental results [1-3] on anisotropic propagation of SPPs obtained for Ag surfaces coated by oriented molecular layers are discussed. Our results demonstrate clearly that the magnitude of the wavevector of SPPs changes depending on its direction.

In the second part of this presentation, the polarization-hybridized nature of SPPs, which is another important consequence of the anisotropy, is discussed on the basis of simulation results briefly summarized below. We assume a Kretschmann configuration consisting of a prism, Au thin film and anisotropic dielectric, as shown in Fig. 1. We calculate the reflectance as a function of the incident angle θ_{in} for several azimuthal angles φ. The angle φ is defined as the angle between the direction of SPPs propagation and the optical axis of the anisotropic dielectric. Figure 2 shows calculated reflectance curves for *s*-polarized incident light. We clearly see the reflectance dips, which demonstrate that *SPPs can be excited by s-polarized light.* According to detailed analyses of electric field distributions, SPPs propagating at the metal-anisotropic dielectric interfaces are hybridized waves of TE and TM waves and can be excited even by s-polarized light.

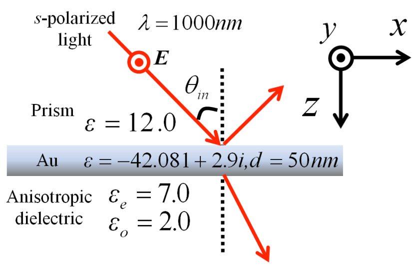

Fig. 1. Krerschmann configuration assumed for calculations.

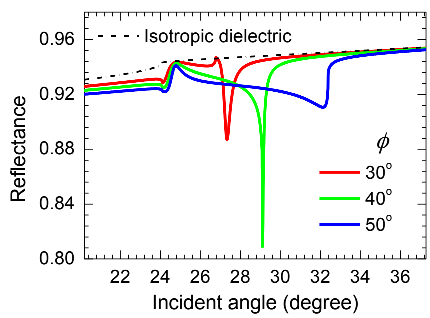

Fig. 2. Refrectance as a function of the incident angle ϑ_{in} for *s*-polarized incident light.

[1] H. M. Hiep, M. Fujii, and S. Hayashi, "Effects of Molecular Orientation on Surface-Plasmon-Coupled Emission Patterns," Appl. Phys. Lett., **91**, 183110 (2007).

[2] Fadiah A. M. Ghazali, M. Fujii, and S. Hayashi, "Anisotropic Propagation of Surface Plasmon Polaritons Caused by Oriented Molecular Overlayer", Appl. Phys. Lett, **95**, 033303 (2009).

[3] Y. Takeichi, Y. Kimoto, M.Fujii, and S.Hayashi, "Anisotropic propagation of surface plasmon polaritons induced by para-sexiphenyl nanowire films," Phys. Rev. B, **84**, 085417 (2011).

Fluorescent platinum nanoclusters: synthesis and characterization

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Metal nanoclusters which are composed of a few to several tens of atoms express unique physical properties due to quantum size effect as compared with bulk metal and plasmonic nanoparticles. For example, the metal nanoclusters exhibit fluorescent capability of which emission wavelength depends on their size or the number of atoms. In this presentation, we will show our platinum nanoclusters emitting blue and green photons [1, 2]. We have synthesized platinum nanoclusters by mixing hexachloroplatinic(IV) (H_2PtCl_6) acid and PAMAM (polyamidoamine) dendrimers in pure water and reducing platinum ions with reductants. Then, the PAMAM dendrimers were exchanged with mercaptoacetic acid and the products were purified with high performance liquid chromatography. Figure 1 illustrates size-exclusion HPLC chromatogram of the supernatant to which mercaptoacetic acid was added. We found four fractions in the solution by monitoring UV absorption at 290 nm (red line) and fluorescence at 520 nm (green line). Figure 2 shows excitation-emission matrix spectrum for the fourth fraction (fraction 4 in Fig. 1). We have a single fluorescent component at 520 nm in the fraction 4. Then, we performed electrospray ionization (ESI) mass spectroscopy of chemical constituent in the fraction 4 and obtained a main peak at m/z = 2353.22. The result represents that synthesized nanoclusters have composed of 8 platinum atoms. Details of optical properties of the nanoclusters and their application to bio-imaging will be shown in the presentation.

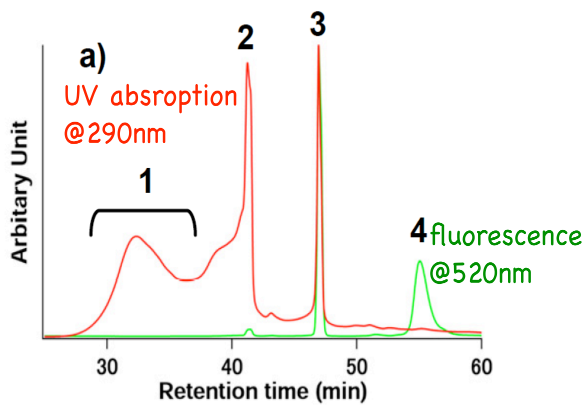

Fig. 1 Size-exclusion HPLC chromatogram.

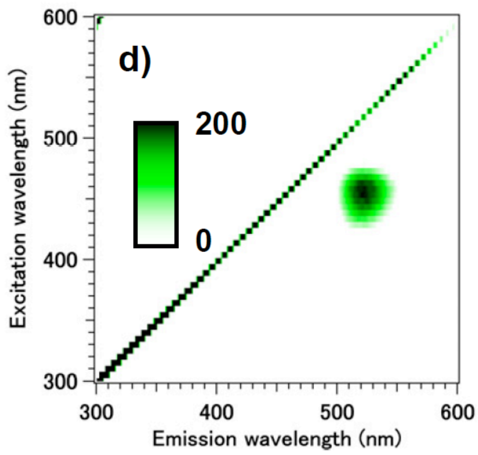

Fig. 2 Excitation-emission matrix spectrum of the fraction 4.

References

[1] S. Tanaka, J. Miyazaki, D.K. Tiwari, T. Jin, and Y. Inouye, Angew. Chem. Int. Ed., ***50***, 431–435 (2011).
[2] S. Tanaka, K. Aoki, A. Muratsugu, H. Ishitobi, T. Jin, and Y. Inouye,, Optical Materials Express, ***3***, 157-165 (2013).

All Fibre devices for sensors and telecommunications applications

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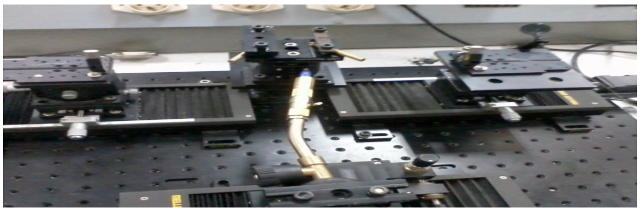
The fibre is not only the choice transmitting medium for high speed long haul telecommunication. It is also currently used in sensing networks applications and more recently in quantum information system. All fibre devices are essential components of optical network systems and sensors for industrial and biomedical applications. Development of such components is of great importance to allow networks and sensors functions to be performed in the glass of the optical fiber itself [1]. That makes them particularly attractive to perform operations such as multiplexing, routing or filtering with high optical performances: low insertion loss, low polarization dependent loss and low polarization mode dispersion. Among of all fabrication techniques, the fused fiber biconical taper (FBT) technique allows fabrication of high performances optical devices. Although fibre devices are mainly based on the passive directional coupler basic structure, research is made to develop new optical structures that perform complex functionalities supported by polarization, phase and power [2,3,4,5,6]. Recent developments on all-fibre structures at INPT are presented. Research is mainly focused on enhanced fabrication techniques and stability of FBT fabrication technique, passive thermal compensation for stable optical structure over wide temperature range, broadband spectral operation for multi wavelength operations and new interferometer design. Recent developments on all-Fibre polarization maintaining evanescent-based structures are presented for multi-information sensors and polarization stability optical devices for new generation optical networks [7].



FBT fabrication devices at INPT

1. N. Azami and S. Lacroix "Optical Fibers Research Advances", éditeur: Jürgen C. Schlesinger, maison d'édition: Nova Publishers (New York) "Recent developments on all-fibres devices for optical networks", Nova Publishers, New York, Chap. 7, pp. 205-229, 2007.
2. N. Azami, F. Gonthier; A. Villeneuve E. Villeneuve "All State of Polarization All fiber linear design depolarizer", United States Patent No: 7,206,465 B2. Date of Patent: Apr. 17, 2007
3. F. Gonthier, L. Martineau, F. Séguin, A. Villeneuve, M. Faucher, N. Azami, M. Garneau, "Optical Coupler comprising multimode fibers and method of making the same"
4. United States Patent No: 7,046,875 B2. Date of Patent: May 16, 2006
5. N. Azami, F. Gonthier; A. Villeneuve E. Villeneuve, "All fiber linear design depolarizer"
6. United States Patent No: US 6,847,744 B2. Date of Patent: Jan. 25, 2005
7. N. Azami , "All fiber Broadband Polarization Combiner" United States Patent No: US 6,996,298 B2. Date of Patent: Feb. 7, 2006
8. N.azami, "Method of adjustment of thermal dependence in an optical fiber" United States Patent No: US 6,631,232 B1. Date of Patent: Oct. 7, 2003.
9. N. Azami, D. El Idrissi, "Méthode de fabrication de composants optiques a base de fibres optiques à maintient de polarisation à cœurs exposés ». Application Patent OMPIC 35455, Dec. 13, 2012.

Solution Processable Phthalocyanine-based Solar Cell with High Performance

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Low cost and high efficient solar cell has earnestly been desired for a sustainable world. The use of self-assembling characteristics is one of the most potential candidates for the realization of a prevailing solar cell. We have demonstrated a high-efficient bulk-heterojunction solar cell based on liquid crystalline phthalocyanine $C6PcH_2$ exhibiting a high carrier drift mobility in excess of 1 cm^2/Vs. The device can be fabricated through a spin-coating process from the blend solution of $C6PcH_2$ and 1-(3-methoxy-carbonyl)-propyl-1-1-phenyl-(6,6)C_{61} (PCBM). For the formation of the optimally phase-separated nano-structure for efficient carrier generation and transportation, the mesogenic properties should play an important role. Solar cells have demonstrated a high external quantum efficiency above 70% in the Q-band absorption region of $C6PcH_2$ and a high energy conversion efficiency of 3.1%. By inserting MoO_3 hole transport buffer layer between the positive electrode and active layer and by incorporating additives into active layer for morphorogy optimization, the fill factor FF and energy conversion efficiency were improved to be 0.55 and 4.2%, respectively. The tandem organic thin-film solar cell has also been studied by utilizing active layer materials of $C6PcH_2$ and poly(3-hexylthiophene) (P3HT) and the interlayer of LiF/Al/MoO_3 structure, and a high V_{oc} of 1.27 V has been achieved. $C6PcH_2$ is also available as a dopant for conventional organic thin-film solar cells with an bulk hetero-junction active layer composed of P3HT and PCBM. The improvement of long-wavelength sensitivity in P3HT:PCBM bulk hetero-junction solar cells by doping $C6PcH_2$ has been succeeded.

References

1. T. Hori, Y. Miyake, N. Yamasaki, H. Yoshida, A. Fujii, Y. Shimizu and M. Ozaki, *Appl. Phys. Express*, **3**, 101602 (2010).
2. Y. Miyake, Y. Shiraiwa, K. Okada, H. Monobe, T. Hori, N. Yamasaki, H. Yoshida, M. J. Cook, A. Fujii, M. Ozaki and Y. Shimizu, *Appl. Phys. Express*, **4**, 021604 (2011).
3. T. Hori, N. Fukuoka, T. Masuda, Y. Miyake, H.Yoshida, A. Fujii, Y. Shimizu and M. Ozaki, *Solar Energy Materials and Solar Cells*, **95**, 3087 (2011).
4. T. Hori, T. Masuda, N. Fukuoka, Y. Miyake, T. Hayashi, T. Kamikado, H.Yoshida, A. Fujii, Y. Shimizu and M. Ozaki, *Organic Electronics*, **13**, 335 (2012).
5. T.Masuda, T.Hori, K.Fukumura, Y.Miyake, D.Q.Duy, T.Hayashi, T.Kamikado, H.Yoshida, A.Fujii, Y.Shimizu, and M.Ozaki, *Jpn. J. Appl. Phys.*, **51**, 02BK15 (2012) .
6. T.Hori, Y.Miyake, T.Masuda, T.Hayashi, K.Fukumura, H.Yoshida, A. Fujii, Y. Shimizu and M. Ozaki, *J. Photonics for Energy*, **2**, 021004 (2012).
7. Q.D.Dao, T. Hori, T. Masuda, K. Fukumura, T. Kamikado, F. Nekelson, A. Fujii, Y. Shimizu, and M. Ozaki, *Jpn. J. Appl. Phys.*, **52**, 012301 (2012).
8. Q.D.Dao, T.Hori, K.Fukumura, T.Masuda, T.Kamikado, A.Fujii, Y.Shimizu, and M.Ozaki, *Appl.Phys.Lett.*, **101**, 263301 (2012).

Transparent conducting oxide thin films for solar cells

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Abstract

Transparent Conducting Oxide (TCO) are multifunctional semiconductors with wide band gap [1]. Due to their tunable optoelectronic characteristics they are commonly used as front and back transparent conductors in various photovoltaic solar cells architecture [2-3].
Rare-earth (RE) doped large band gap semiconductors are particularly of potential interest to reach the down conversion function [4]. The idea is to reduce the thermalization losses occurring in solar cells by transforming a high energy photon into two photons of lower energy. In such materials absorption of photons takes place via excitation of the host material. Auger processes and energy transfer processes between the host matrix and the doping ions is able to involve in the excitation of two rare earth ions after only one incoming photon.
Fluorine tin oxide (FTO), aluminum doped zinc oxide (AZO) and RE (Yb, Nd, Tm...)-doped ZnO thin films were prepared on glass substrates by spray pyrolysis technique. All of these sprayed thin films were polycrystalline with a preferential orientation. High transmittance and low electrical conductivity values were obtained. For RE-doped ZnO, efficient energy transfer from ZnO matrix to the RE ions and other interesting optical properties were observed.

References:

[1] C. G. Granqvist, "Transparent conductors as solar energy materials: A panoramic review", Solar Energy Materials & Solar Cells 91 (2007) 1529.

[2] P. Jackson, D. Hariskos, E. Lotter, S. Paetel, R. Wuerz, R. Menner, W. Wischmann and M. Powalla, "New world record efficiency for Cu(In,Ga)Se2 thin-film solar cells beyond 20%", Prog. Photovolt: Res. Appl. 19 (2011) 894.

[3] K. SöDerström, G. Bugnon, R. Biron, C. Pahud and F. Meillaud et al, "Thin-film silicon triple-junction solar cell with 12.5% stable efficiency on innovative flat light-scattering substrate", J. Appl. Phys. 112 (2012) 114503.

[4] T. Trupke, M. A. Green and P. Würfel, "Improving solar cell efficiencies by down conversion of high-energy photons", J. Appl. Phys. 92 (2002) 1668.

All-Optical Contact-Free Probing of Solid/Liquid-Water Interface by Nanoultrasonics with Sub-Nanometer Resolution

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Solid/liquid-water interface is of fundamental importance in various phenomena ranging from surface wetting, electrolysis, to protein folding. Despite the development of techniques for investigating solid/liquid-water interface, the angstrom-scale feature and the picosecond structural relaxation dynamics of water molecules have made it challenging to experimentally understand how water molecules interact with the substrate and each other. Here we apply femtosecond laser pulses to generate nanoacoustic waves with a subnanometer pulsewidth to noninvasively diagnose the viscoelastic characteristics of hydration structures at ambient solid surfaces. The observed ultrafast acoustic impulse response of the interfacial water quantitatively indicates that the liquid water next to the studied hydrophilic solid surface is 3 to 7 times denser and more rigid, and 90% to 80% less viscous than bulk liquid water. This all-optical, non-invasive ultrasonic study provides key information for energy transfer at solid-water interface as well as structures and bonding strengths of the interfacial hydration water.

Magnetic and electronic properties of new half-metals

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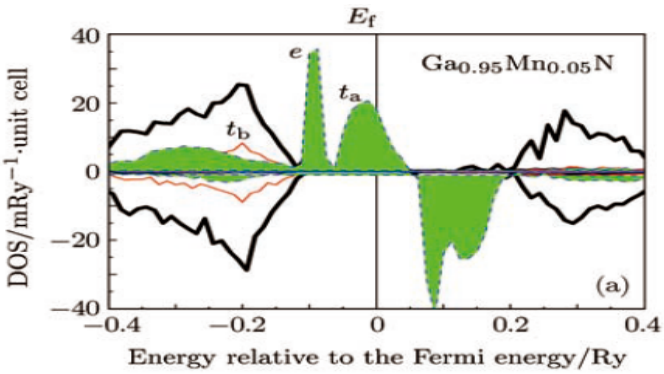
Half metals are ferromagnets whose density of states shows only one occupied spin-polarized sub-band, either spin up, ↑, or spin down, ↓, at the Fermi energy. Half metals are compounds of more than one element and are mostly oxides or Heusler alloys [1, 2].
Half metals have great potential for spin electronics as they can be used as sources and analysts of fully spin polarized electrons in device structures. An important tunneling magnetoresistance effect has been observed, at low temperature, in a half-metallic ferromagnetic oxide La2/3Sr1/3MnO3 [3, 4]. However, the Curie temperature (Tc) of this oxide hardly exceeds room temperature and the TMR effect disappears around 300K, what makes this material unsuitable for applications. Other half-metallic oxides, with higher Curie temperatures were then considered, including the double perovskites Sr2FeMoO6 (Tc=420 K) [5] or the chromium oxide CrO2 (Tc=395 K).
In this presentation, new half-metallic materials based on doped oxides, including ZnO, SnO2, TiO2, obtained using ab initio calculations, are given [6-9]. Special attention is paid to the effect of defects (intersite, antisites and vacant sites) on the magnetic properties and the half metallic behavior of these oxides. The transition temperatures of these materials have been calculated using mean field approximation, effective field theory and Monte Carlo simulation.



Total and partial DOS of Ga0.95Mn0.05N

[1] I. Galanaskis et al., Phys. Rev B 66, 134428 (2002)
[2] I. Galanaskis et al., Phys. Rev B 66, 134428 (2002)
[3] M. Viret et al., EuroPhys. Lett., 39, 545 [1997]
[4] M. Bowen et al., Appl. Phys. Lett., 82, 233 [2003]).
[5] K.I. Kobayashi et al., Phys. Rev. B 59, 11159 (1999).
[6] N. Mamouni, A. Benyoussef, A. El Kenz, H. Ez-Zahraouy and M. Bououdina; J Supercond Nov Magn (2012) doi:10.1007/s10948-012-1779-7
[7] Khalil, B. , Labrim, H. , Mounkachi, O. , Belhorma, B. , Benyoussef, A. , Kenz, A. , Belhaj, A., Journal of Superconductivity and Novel Magnetism, 26 (1), p.151-156, Jan 2013
[8] Salmani, E. , Mounkachi, O. , Ez-Zahraouy, H. , El Kenz, A. , Hamedoun, M. , Benyoussef, A., Journal of Magnetism and Magnetic Materials, 330, p.141-146, Mar 2013
[9] Salmani, E. , Mounkachi, O. , Ez-Zahraouy, H. , Hamedoun, M. , Benyoussef, A., Journal of Superconductivity and Novel Magnetism, 26 (1), p.229-236, Jan 2013

Novel applications of atmospheric pressure plasmas with room temperature to medicine and biomaterial

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Medical application of plasma is one of attracting interdisciplinary fields. Atmospheric pressure plasmas, as shown in Fig. 1, with room temperature have been used for a wide variety of medicine and biomaterial fields. Especially, plasma treatment of human body is thought to be applicable to disinfection, wound healing, blood coagulation and so on. Many interesting experimental results have been reported, but the discussion about function mechanism of plasma (the role of plasma) is not sufficient. For that purpose, I have formed a collaborative research group including over 50 researchers of plasma physics, numerical simulation, physical chemistry, analytical chemistry, chemistry, biochemistry, molecular biology, dentistry and medicine.

Avoiding unwanted thermal effect, new device for atmospheric pressure plasma with room temperature ,cold plasma, has been developed (Fig. 1). As shown in Fig. 2, this LF (Low Frequency) plasmajet is enough cold to touch it. Considering human body, some reaction should be induced inside body fluid by plasma exposure. The concept of "plasma-induced chemical reaction in liquid" is very important. In gas phase, various species (ions, electrons, radicals UV, and so on) are generated inside/surface plasma. Some of them diffuse outside plasma plume as an air ion. Hence, these active species can be supplied from the interface between gas and liquid phases. In the liquid phase, active species penetrate from the surface of the liquid. The penetration is limited by many chemical reactions, and each concentrations of species are distributed. Some are called as reactive oxygen species. Unlike usual chemical reaction, spatially non-uniform reaction field is obtained. Then, supplied active species react with biomacromolecules (protein, amino acid, lipid, sugar and so on.) [1]. As a result of many types of reaction (oxidation, nitration, hydrolysis...) to biomacromolecules, several types of biological processes occur. Some of processes are beneficial for health.

Plasma is not an instrument of magic. It is important for beneficial use of plasma to find applications which can not be treated by other methods. One of our answers is the disinfection of human body. Plasma can bring strong bactericidal activity limited on the surface of human body, which avoid ill effect for living body. For that purpose, my group developed the reduced pH method with strong bactericidal activity, which changes D value (1 log reduction time of bacteria count) to 1/100 [2]. It has been also found that the presence of superoxide anion radicals (O_2^-•) in water and the air is essential. The critical pH value may be associated with p*K*a of the dissociation equilibrium between O_2^-• and hydroperoxy radicals (HOO•), which is known to be approximately 4.8. This means that O_2^-• can be changed into HOO•, which have much stronger bactericidal activity, in lower pH. Half lifetime of O_2^-• is adequate for the disinfection. One purpose of the applications is root canal sterilization for dental treatment. Many types of *in vitro* experiments have been successfully done with infected human extracted tooth [3]. Now *in vivo* animal experiments have been done for dental and medical application (Fig.3).

In addition, this cold plasma can be used for the synthesis of gold nanoparticle by reduction, biointerface polymer by cross-linking, for near-infrared bioimaging nano phosphor by surface modification and so on.

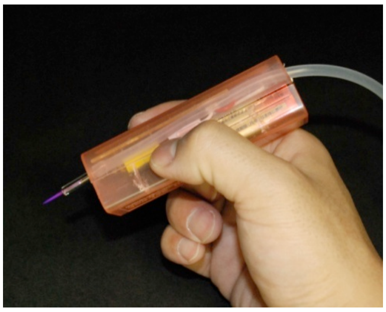

Fig. 1 Handy plasma device with electrode, high-voltage power supply and battery. Cost is < 10 USD.

Fig. 2 LF (low frequency) plasma jet exhausted to a finger without burning.

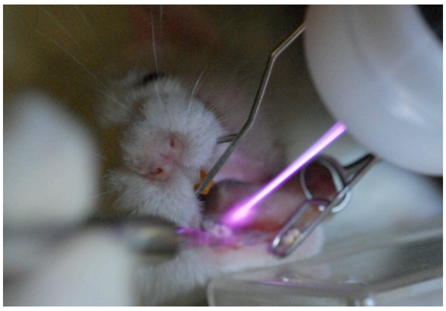

Fig. 3 *in vivo* experiment for root canal therapy.

[1] E. Takai, K. Kitano, J. Kuwabara, K. Shiraki, Plasma Process. Polym., 9, 77-82, (2012).
[2] S. Ikawa, K. Kitano, and S. Hamaguchi, Plasma Process. Polym., 7, 33 (2010).
[3] H. Yamazaki, T. Ohshima, et al., Dental Mat. Journal, 30, 384 (2011).

Thermoelectric Properties of Phosphates Glasses/Metal Composites

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In this communication, we report the electrical conductivity (**σ**) and Seebeck coefficient (**S**) of ZnO-P_2O_5 matrix filled with conductive powder of nickel (Ni). The variation of **σ** versus volume fraction of Ni showed at percolation threshold (28Vol. %) a non-conducting to conducting phase transition. The change of **S** from high positive to negative values exhibits that this transition is accompanied by the passing of carrier charge from p to n type. On the other hand, the measurements of σ and S as function of temperature, above the percolation threshold, showed a Positive Temperature Coefficient (**PTC**) phase transition at Tc≥400K; linked with a high S≈-5000μV/K, giving highest power factor $PF=\sigma S^2 \approx 2.10^{-4} W.m^{-1}.K^{-2}$. The temperature dependence of the volume expansion enabled to confirm that this transition is associated to the thermal volume variation in matrix. However, the temperature dependence of σ below the percolation threshold showed two different mechanisms: thermally activated hopping behavior at high temperatures and Mott's Variable Range Hopping (VRH) at low temperatures. The change of carrier type conduction (p-n) and obtained highest power factor should be giving a new opportunity to use these materials in PTC devices and photovoltaic active cellular layers.

Keywords: Composites; Electrical properties; Glass ceramics; PTC devices, percolation

References:

1. A. Maaroufi , O. Oabi, G. Pinto, M. Ouchettoc, R. Benavente, J.M. Pereña, Journal of Non-Crystalline Solids 358 (2012) 2764–2770.
2. A. Maaroufi, O. Oabi, B. Lucas, A. El Amrani, S. Degot, Journal of Non-Crystalline Solids 358 (2012) 3312–3317.

Abstracts for Poster Presentations

Laser Induced Micro-Nano Structures on Metallic Thin Films

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Abstract

Nonlinear optical interaction is the new mantra of a rapidly growing and evolving research community harnessing the novel interaction physics of femtosecond laser light. Laser micro- and nanofabrication is based on the interaction of light with solid matter. As a result of the complex interaction between light and matter, small amounts of material can be removed from the surface. We discuss experimental data of surface micro structures on Titanium and Molybdenum thin films for biological applications (tissue engineering). Thin films of different thicknesses have been deposited on glass and silicon substrates by E-beam evaporator technique. Film thicknesses and elemental composition of films & substrates were deliberated by Rutherford Backscattering Spectroscopy (RBS) technique. X-Ray crystallography reveals single phase and mono crystalline behaviour of the samples. By varying laser influence during the micromachining process, atomic force microscopy (AFM) analyses of these periodic structures were demonstrated the ablation threshold of material. Optical microscope (OM) images substantiate the periodic structures on metallic thin films.

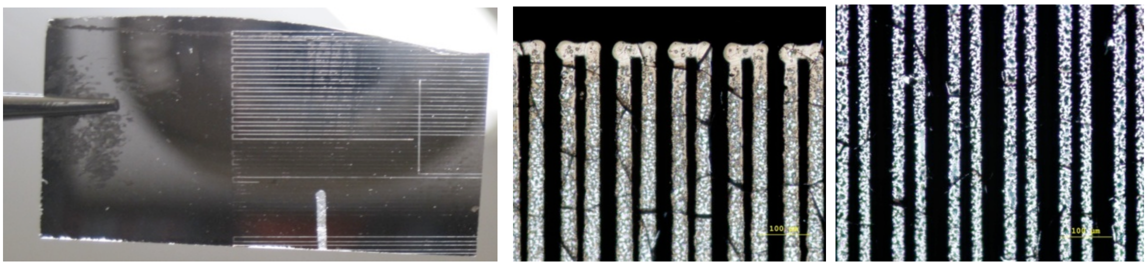

Figure: Microstructures machined on a Titanium thin film surface by the femtosecond laser. (a) a snapshot of periodic structures on Ti thin film (800nm) deposited on glass substrate. (b) Optical microscope (OM) image of microstructures created by fs laser at 500mW on 800 nm Ti film top view. (c) OM image of microstructures middle view.

1. O. Svelto and D. Hanna, Principles of Lasers, 4th edition, New York: Plenum Press, ©1998, ISBN: 0306457482.

NOTE: This work is still in progress for further analysis e.g. SEM analysis and designing/decoration of biological tissues on these micro structures etc. for different applications.

Enhancement and Control of Fluorescence Emission of Molecules in a Nanoaperture with Plasmonic Corrugations

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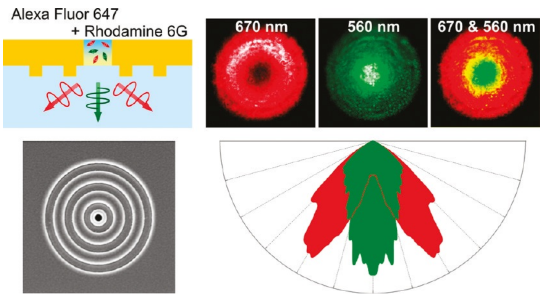
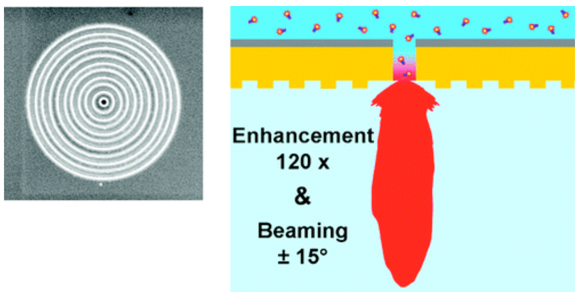
Controlling the fluorescence emission from nanoscale quantum emitters is a key element for a wide range of applications, from efficient analytical sensing to quantum information processing. Enhancing the fluorescence intensity and narrowing the emission directivity are both essential features to achieve a full control of fluorescence, yet this is rarely obtained simultaneously with optical nanoantennas. Here we report that gold nanoapertures surrounded by periodic corrugations transform standard fluorescent molecules into bright unidirectional sources. We obtain enhancement factors of the fluorescence count rate per molecule up to 120 fold simultaneously with a directional emission of the fluorescence into a narrow angular cone in the direction normal to the sample plane [1]. Moreover, we present a full directional control of the fluorescence emission from molecules in water solution by the same nanoantenna, the fluorescence beam can be directed along a specific direction with a given angular width [2]. These results are highly relevant for the development of single molecule sensing, single-photon sources, and light emitting devices.





[1] Aouani, H.; Mahboub, O.; Bonod, N.; Devaux, E.; Popov, E.; Rigneault, H.; Ebbesen, T. W.; Wenger, J. Nano Letters. 11, 637–644, 2011.

[2] Aouani, H.; Mahboub, O.; Devaux, E.; Popov, E.; Rigneault, H.; Ebbesen, T. W.; Wenger, J.; Nano Letters 11, 2400–2406, 2011.

On the resolution of sensors based on optical resonances

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The estimation of the resolution of surface plasmon resonance (SPR) sensor directly related to its sensitivity is important for characterization of a smallest detectable change in the refractive index of the bulk medium and the change in optical thickness of an adsorption layer [1]. We analytically introduce two figures of merit (FOMs) for estimation of achievable resolution of surface plasmon (SP) sensors with intensity modulation (IM) and spectral modulation with data post-processing (SMPP) [2]. The resolution of SP sensors in the Kretschmann's geometry is estimated by numerical simulation for combinations of silver (Ag), copper, aluminum (Al) with gold coating layer in the ultraviolet (UV), visible, and infrared regions for both bulk media and thin layer sensing. Comparison of the conventional SPR sensor structure and different types of optical sensors shows that implementation of Cr and Ti as adhesion layers for Au deposition makes the resolution worse (especially for SMPP sensor) without noticeable shift of optimal wavelength. Implementation of Ti as an adhesion material provides better resolution. The structures with Ag covered by Au can exhibit better resolution. For AMPP sensor: Ag(41 nm)/Au(5 nm)@0.56 μm is 45% better compared to Cr/Au; for IM sensor: Ag(49 nm)/Au(5 nm)@0.83 μm is 26% better. Application of Cu in sensor leads to worsening resolution. Al single layer sensors have a resolution minimum in the UV region which is 3.5 times better compared to Cr/Au for AMPP sensor. The demand for application of alternative covering protection materials for Al in the UV region and for Ag in the visible region to improve the resolution of AMPP sensor for thin layer detection is demonstrated.

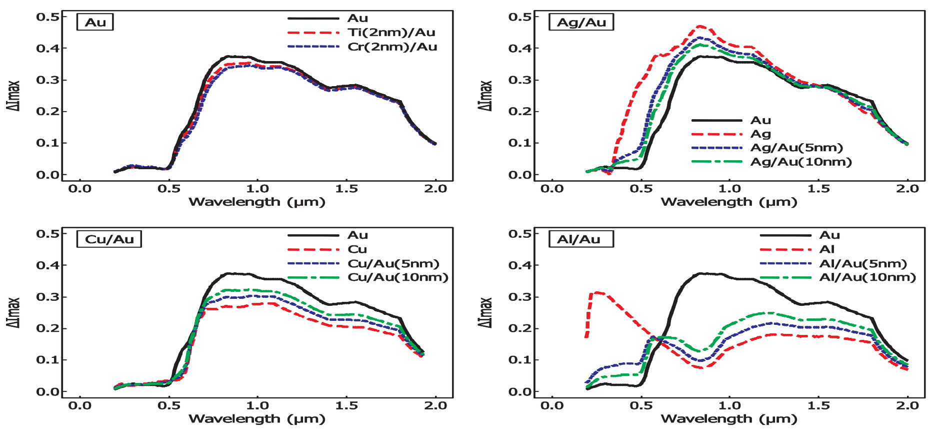

Fig. 1. Wavelength dependence of the maximal change in the reflected intensity of Au, Ag, Cu, and Al SPR sensor as figure of merit for estimation of the resolution of adsorption layer sensing by the single and bilayer sensors with intensity modulation.

1. J. Homola, Chem. Rev. 108, 462-493 (2008).
2. D. V. Nesterenko, R. Saif ur, and Z. Sekkat, Appl. Opt. 51, 6673-6682 (2012).

Plasmonics at Metallic Thin Layers

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Plasmonic excitation and the associated sub-wavelength light-matter interaction has opened new and fascinating avenues for research that originates from the observations and theoretical predictions of several unique properties of surface plasmon waves propagating on metal-dielectric interfaces. We discuss experimental data of surface plasmon resonance (SPR) occurring at single and double metal layers of Au and Ag. Refractive indices and thicknesses of the layers were estimated by analytical modeling. Thickness and roughness were measured by AFM. The influence of the roughness of the metallic surfaces on SPR curve shape was demonstrated. Atomic force microscopy (AFM) analysis of these metal layers complements the surface plasmons characterization. We found that the result of AFM experiment has the close thickness values with the theoretical assumptions of films thicknesses.

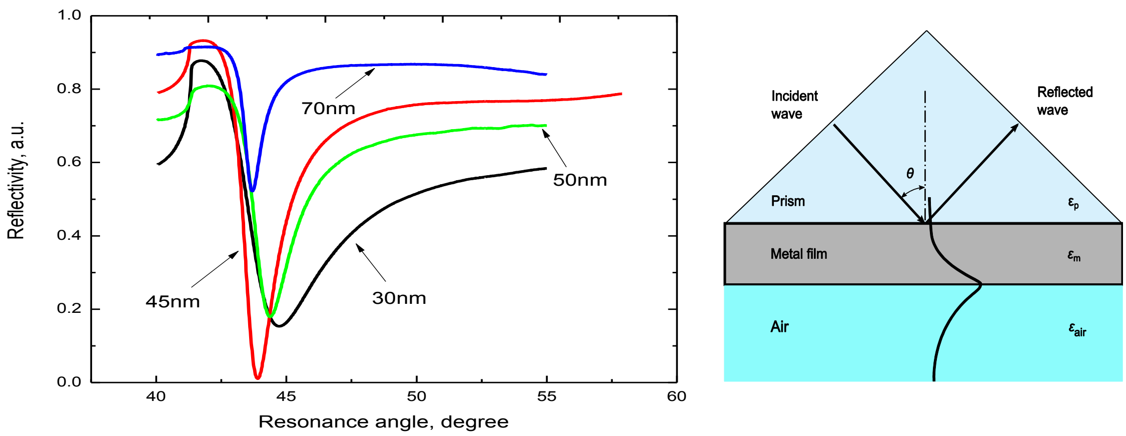

Figure: Surface plasmon resonance of glass/Au substrate taken at different thicknesses (30nm, 45nm, 50nm & 70nm). The insert shows the ATR setup for the excitation of surface plasmons in Kretschmann geometry.

1. T. Mahfoud, Z. Sekkat, et al. «High quality nano-patterned thin films of the coordination compound {Fe(pyrazine)[Pt(CN)(4)]} deposited layer-by-layer» New Journal of Chemistry 35 (10) 2011.
2. D.V. Nesterenko, S. Rehman, and Z. Sekkat "Surface plasmon sensing with different metals in single and double layer configurations", Applied Optics 27 (51), 6673, (2012).

Elaboration and Characterization of ZnO Doped by Al as Thin Transparent Oxides for Photovoltaic Applications

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ZnO:M (M= Al, Ga, In) thin films with high *c*-axis orientated crystalline structure along (002) plane are extensively studied for practical applications including transparent conducting electrode materials for various electronic devices such as solar cells, electroluminescence displays, etc. In the present study, Al-doped ZnO (AZO) films were prepared on glass substrate by sputtering method using three targets ZnO, ZnO@Al2O3 and Al. The crystal orientation, electrical and optical properties with concentration doping was systematically investigated via X-ray diffraction (XRD), atomic force microscopy (AFM), Hall Effect measurements and ultraviolet visible (UV–Vis-NIR) spectrophotometer. The as-prepared sputtered ZnO:Al films are promising candidates as front electrode in a variety of solar cells application and opto-electronic devices.

Synthesis of Arrayed ZnO nanorods by Wet Chemical Method for Photovoltaic Applications

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We present in this work the synthesis of ZnO nanorods on transparent conducting oxides, Al doped ZnO seed layer on glass substrate (AZO) and indium tin oxide substrate (ITO) by using zinc nitrate hexahydrate (Zn (NO3)2·6H2O) and Hexamethylenetetramine (HMT, (CH2)6N4 as raw materials. The ZnO seed layer was made by depositing an Al- doped ZnO thin film on glass substrate by sputtering. The synthesized nanostructures of ZnO were characterized by X-ray diffraction (XRD), UV–Vis absorption spectrophotometer, atomic force microscopy (AFM) and scanning electron microscopy (SEM). The results indicated that all the nanostructures of ZnO were preferentially grown as nanorods along [002] direction (c-axis) of the hexagonal wurtzite structure.

Electronic Structure and Optical Properties of Fe, Mn, V, Co, Ni and Cr doped GaN and ZnO

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We investigate the electronic structure, magnetic and optical properties of (Ga,TM)N and (Zn ,TM)O semiconductor with TM (Co, Mn, Ni, Fe, V, Cr) based dilute magnetic semiconductors (DMS) from first-principles. The electronic structure and optical properties of DMS is calculated by using the self-interaction-corrected local density approximation (SIC-LDA) and compared with local density approximation (LDA) calculated by using the Korringa–Kohn–Rostoker coherent potential approximation (KKR-CPA) method [1-3]. In the ferromagnetic (FM) ordering, same of this DMS's is half-metallic with LDA and LDA-SIC approximations and is therefore ideal for spintronic and optoelectronic application. The optical absorption spectra obtained by ab-initio calculations confirm the ferromagnetic stability based on the charge state of magnetic impurities.

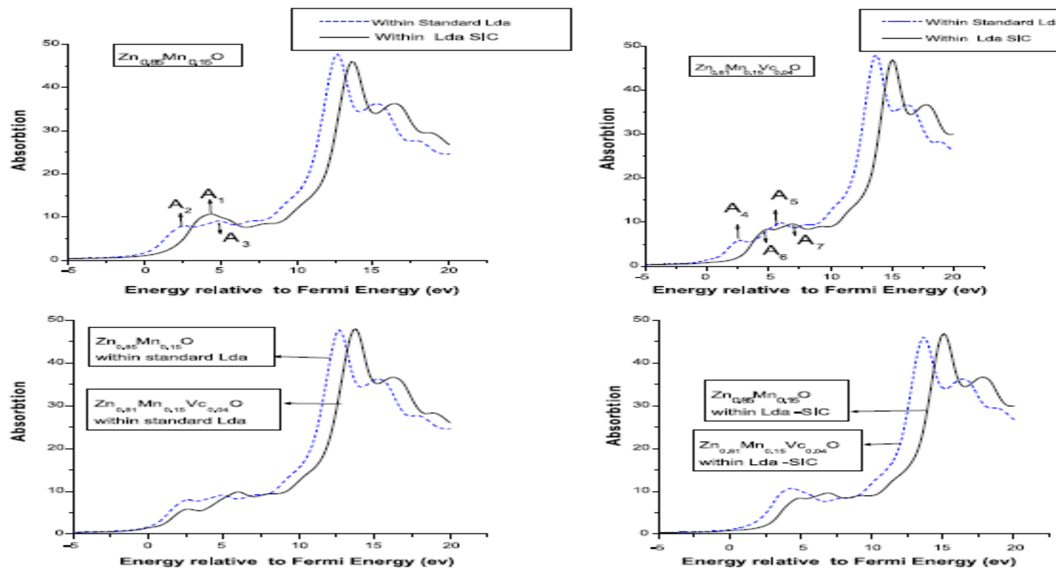

Fig. 1: Calculated X-ray absorption spectrum at the K-edge of Mn in wurtzite $Zn_{1-x}Mn_xO$ (x = 0.15): for $Zn_{0.85}Mn_{0.05}O$ and$Zn_{0.81}Mn_{0.15}Vc_{0.04}$ within standard LDA and the self interaction corrected LDA

[1] H. Akai, P.H. Dederichs, Phys. Rev. B47 (1993) 8739.
[2] H. Akai, Phys. Rev. Lett. 81 (1998) 3002.
[3] Salmani, E. , Mounkachi, O. , Ez-Zahraouy, H. , El Kenz, *A.* , Hamedoun, M. , *Benyoussef, A.*, Journal of Magnetism and Magnetic Materials, 330, p.141-146, Mar 2013

Optical properties of ZnTe doped with transition metals (Cr, Mn and Ti)

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The electronic and optical properties of ordered Zn1-xMxTe with (M= Cr, Mn, Ti) alloys have been investigated, within generalized gradient approximation (GGA) using the full potential linear augmented plane wave (FP-LAPW) method as implemented in the WIEN2K code. This work presents detailed information about optical properties like absorbance, refractive index and reflectivity. The result of this study shows that doped ZnTe material with Cr, Mn and Ti shift the absorption spectrum and reflection to the infrared spectral domain or to the ultra violet region, depending on the nature of the dopant. Dielectric functions for different compositional alloys are calculated for 16-atom cubic supercell structure. The calculated band gaps are fitted with a linear equation: $(\alpha h\nu)^2 = A(h\nu\text{-}Eg)$. For all types of doping, the position of critical points (CP's) E_0, E_1 and E_2 show good agreement with the experimental data.

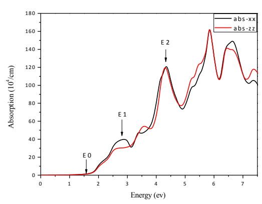	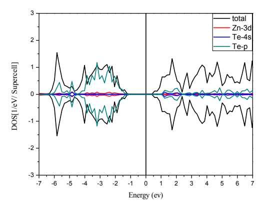	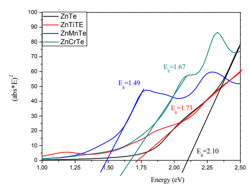	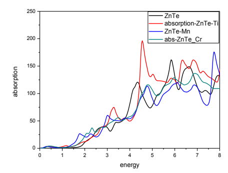
Fig 1: Absorption spectrum of ZnTe as function of photon energy	Fig 2: Total and partial electronic density of states of ZnTe	Fig 3: Determination of gap energy in ZnTe bulk and ZnTe doped with Ti,Mn and Cr using the equation: (αhν)2 = A(hν-Eg).	Fig 4: Absorption Spectrum as function of photon energy for ZnTe doping with Mn, Cr and Ti

[1] A. K. Aqili, Z. Ali and A. Maqsood, « Optical and structural properties of two-sourced evaporated ZnTe thin films », *Applied Surface Science*, vol. 167, n°. 1-2, p. 1-11, oct. 2000.

[2] P. Dufek, P. Blaha, and K. Schwarz, "Applications of Engel and Vosko's generalized gradient approximation in solids," *Phys. Rev. B*, vol. 50, no. 11, pp. 7279–7283, Sep. 1994.

[3] A. Kaneta et S. Adachi, « Photoreflectance study in the E1 and E1 +Delta 1 transition regions of ZnTe », *Journal of Physics D: Applied Physics*, vol. 33, n°. 8, p. 901-905, avr. 2000.

[4] K. Sato and S. Adachi, « Optical properties of ZnTe », *Journal of Applied Physics*, vol. 73, n°. 2, p. 926, 1993.

[5] E. Erbarut, « Optical response functions of ZnS, ZnSe, ZnTe by the LOM method », *Solid State Communications*, vol. 127, n°. 7, p. 515-519, aug 2003.

XMCD studies and magnetic properties of ZnTe doped with Mn, Cr, Ti and Co

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Abstract

Using the full potential linear augmented plane wave (FP-LAPW) method as implemented in the WIEN2K code in connection with the Generalized Gradient Approximation (GGA). This work present the magnetic properties of ZnTe doped with some transitions metals element. In addition, we study the X-ray absorption spectra (XAS) and X-ray Magnetic circular dichroism (XMCD) calculations to compute the orbital and spin moments separately. Two principal examples will be given: The induced magnetic moments ZnTe of the light and heavy 3d elements (Ti, Cr and Mn, Co) can be determined by the XMCD sum rules analysis at the $L_{2,3}$ edges. Moreover, it has been found that for the lighter 3d elements the spin-orbit splitting of the transitions $2P_{1/2}$ and $2P_{3/2}$ states reduces toward, which has a consequence that two excitations are coupled.

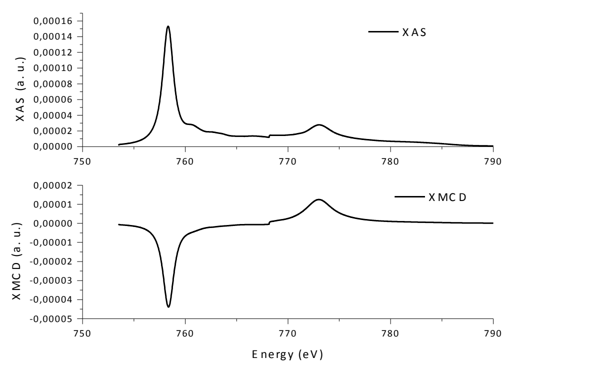

Fig 1: X-Ray absorption and dichroic spectra at $L_{2,3}$ edge of Co doped ZnTe

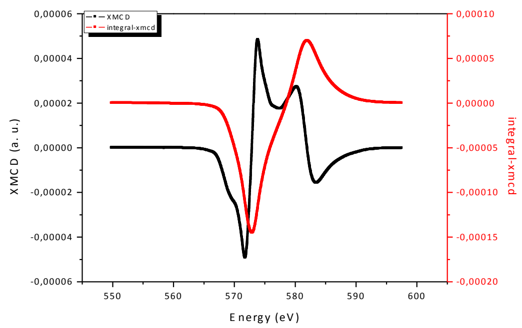

Fig 2: XMCD spectra for the $L_{2,3}$ edge of Cr doped ZnTe

[1] B. T. Thole, P. Carra, F. Sette, and G. van der Laan, "X-ray circular dichroism as a probe of orbital magnetization," *Phys. Rev. Lett.*, vol. 68, no. 12, pp. 1943–1946, Mar. 1992.
[2] P. Carra, B. T. Thole, M. Altarelli, and X. Wang, "X-ray circular dichroism and local magnetic fields," *Phys. Rev. Lett.*, vol. 70, no. 5, pp. 694–697, Feb. 1993.
[3] L. Pardini, V. Bellini, F. Manghi, and C. Ambrosch-Draxl, "First-principles calculation of X-ray dichroic spectra within the full-potential linearized augmented planewave method: An implementation into the Wien2k code," *Computer Physics Communications*, vol. 183, no. 3, pp. 628–636, Mar. 2012.
[4] P. Dufek, P. Blaha, and K. Schwarz, "Applications of Engel and Vosko's generalized gradient approximation in solids," *Phys. Rev. B*, vol. 50, no. 11, pp. 7279–7283, Sep. 1994.
[5] Y. Ishida, M. Kobayashi, J.-I. Hwang, Y. Takeda, S. Fujimori, T. Okane, K. Terai, Y. Saitoh, Y. Muramatsu, A. Fujimori, A. Tanaka, H. Saito, and K. Ando, "X-ray Magnetic Circular Dichroism and Photoemission Study of the Diluted Ferromagnetic Semiconductor $Zn_{1-x}Cr_xTe$," *Applied Physics Express*, vol. 1, no. 4, p. 041301, 2008.

Comparative Thermal Degradation Kinetics of Electrically Insulating/Conducting epoxy/Al Composites Under Dynamic Conditions

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Composites of epoxy loaded with metallic powders depict interesting electrical properties. In order to compare and understand the thermal degradation behavior of insulating and conducting composites, the entitled study was undertaken. A composite couple comprising of an insulator and a conductor from epoxy/Al composites was selected and the TGA study was carried out under non isothermal conditions. Comparison of thermal degradation data obtained from epoxy/Al composites with pure epoxy matrix (taken as standard) revealed the fact that introduction of Al in epoxy positively influenced its stability and degradation rate. However, conductive composite tended to thermally stabilize the matrix by offering less degradation rate than the insulator one which showed counter fashion. Detailed kinetic study satisfactorily responded to this behavior in terms of the comparison of kinetic triplets. It is worthy to remark that effective activation energy of insulator composite (196±14kJ/mol) was found less than that of conductor composite (211±12kJ/mol) comparative to their parent (202±11kJ/mol). The most probable reaction model autocatalytic Šestâk Berggren SB (m, n) was found suitable for the thermal degradation of epoxy and its Al-composites; although, this model suggested significant metal-polymer interactions which could be responsible to the polymer-metal interphase formation and to increase the curing rate of matrix.

Keywords: epoxy, polymer-metal composites, TGA, thermal degradation, kinetics

Conducting-non conducting phase transition, with PTC effect in new epoxy/metallic fillers Composites

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Composites were prepared with epoxy resin and conducting metallic powders of Al, Sn, Fe and Zn. The morphology of the filler particles and their dispersion in the matrix has been investigated by Scanning Electron Microscopy (SEM). The obtained pictures show a homogenous phase. The density measurements were undertaken to allow the estimation of the porosity inside the composites and complete the morphology investigations. The X-ray diffraction (XRD) confirms the SEM results and shows an amorphous phase. The measurements of ATR-IR revealed that the filling affect weakly the polymer spectrum, indicating a low interaction between polymer and fillers. Then, the electrical resistance versus fillers contents and temperature was investigated. The obtained results showed a nonlinear behavior indicating non-conducting to conducting phase transition at critical threshold of conducting fillers. The position of conducting threshold is found to depend on the feature and the properties of the fillers: the type, the size and the geometry. The measurements of electrical resistance as function of temperature, above the percolation threshold, showed a Positive Temperature Coefficient (**PTC**) phase transition. The obtained results have been explained on the basis of the statistical percolation theory.

Keywords: Polymer composite; filler; porosity; conductivity; PTC effect; percolation.

Non-Linear Electronic Conductivity of Zinc Phosphate Glasses/Metal Composites

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Zinc phosphate-glasses/metal composites have been successfully prepared. Glass with composition 45mol%ZnO-55mol%P_2O_5 (ZP) has been filled with micro metallic powders (Nickel and Cobalt). The glass matrix thermal stability has been assessed by DTA technique. The composite morphology has been examined by the Scanning Electronic Microscopy, showing a presence of weak porosity inside the obtained composites, which are considered almost homogenous. Their density was measured as function of metallic content. Comparison between the measured and calculated densities exhibits a good coherence and allows the estimation of porosity inside the composites, in good agreement with the SEM observations. The X-Ray Diffraction (XRD) analysis has revealed that the ZP-matrix phase is amorphous when the temperature treatment is below the glass transition temperature Tg. However, the principal peaks observed in the case of the composites have been assigned to the metallic crystals of nickel or cobalt fillers. It has been found that the phosphate glass phase is not affected by the growing of the metallic network. The electronic conductivity measurements versus filler volume fraction have been investigated for the first time on phosphate-glasses/metal composites. These measurements have shown a non–conducting to conducting phase transition. Furthermore, the location of conducting threshold has been found to depend on the amount and nature of filler. The obtained results have been interpreted on the basis of the statistical percolation theory frame.

Keywords: composite materials, glasses, electrical conductivity, phase transitions, percolation

Synthesis and Fluorescence Spectral Behaviors of New Quinoxaline Derivatives

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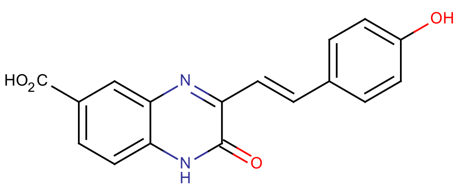
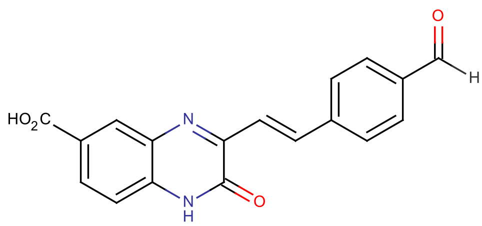
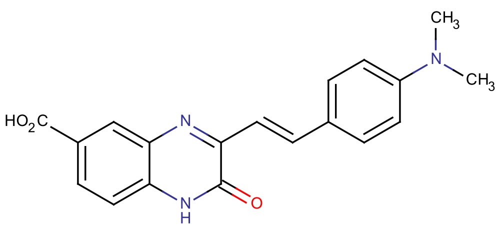
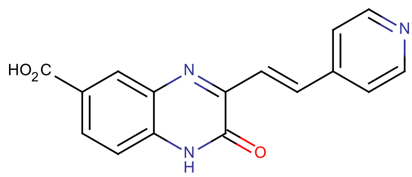
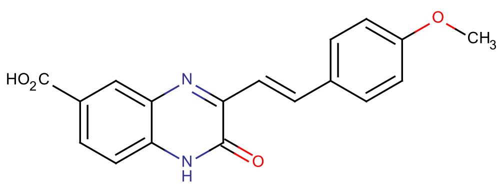
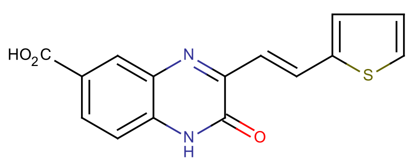
New quinoxaline derivatives were prepared under microwave conditions. Their structures were elucidated using ^{1}H, ^{13}C NMR, FTIR and mass spectrometry, and their fluorescent properties were also investigated in this study.

Chemical and geochemical characteristic of bituminous rocks of the Moroccan Rif

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This work is a part of the evaluation of bituminous rocks (including oil shales) of the Moroccan Rif. The samples were collected from four sites scattered in different regions of northern Morocco, nominated as Tangier (TA), Tetouan (TE), Bab Taza (BT), and Arba Ayach (AA).

All the samples were analyzed by pyrolytic analysis (Rock-Eval 6, Py-GC/MS), thermal analysis (TGA/DTA), elemental analysis (XRF, ICP-AES), microscopic and materials analysis (SEM/EDS, TEM/EDS, XRD), spectroscopic analysis (FTIR, Raman) and chromatographic analysis (GC/MS).

Pyrolytic analyses have shown interesting results for the AA sample in comparison with the other samples. Total Organic Carbon contents (TOC) in the four samples vary from poor to excellent (0.45% à 4.47%). The hydrogen index (HI) and the oil potential (S_1) have shown that the AA sample has a good quality of source rock for hydrocarbons. The results of thermal analysis have shown that the organic part of the four samples is generally range from 4.77% to 7.53%.

The elemental analysis have shown that the element silica (as quartz) is predominant in all samples (32.2-39.3wt %), and the content of the element calcium (5.6wt %) in the TA sample indicates the presence of carbonate which was confirmed by microscopic and materials analysis. The spectroscopic analyses have shown the abundance of CH aromatic structure and the hetero-atomic structure (Si-O-M) in all samples.

In the chromatographic analysis for the extension part of the organic matter for the four samples, all geochemical parameters have confirmed that the AA sample of Arba Ayach has good quality of source rock for hydrocarbons, and rich in aliphatic compounds derived from organic matter of marine origin, the TA sample is rich in polar compounds derived from organic matter of terrestrial origin and the other samples comprise a mixture of polar and aliphatic compounds..

Keywords: Bituminous rock, Moroccan Rif, organic geochemical, GC/MS, Py-GC/MS, pyrolysis, X-ray diffraction, Thermo Gravimetric, X-ray fluorescence, Spectroscopy FTIR, Raman.

Non-isothermal kinetic study of the thermal decomposition of DiCalcium Phosphate Dihydrate $CaHPO_4, 2H_2O$ (DCPD)

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Calcium phosphates constitute a class of materials of special interest in many interdisciplinary fields of science, including medicine, chemistry, food and agriculture. Several studies have been devoted on these compounds to evaluate their physico-chemical and biological properties. Thermal analysis is a complementary technique to X-ray diffraction and IR spectroscopy, often used for kinetic study of degradation process of materials.

DiCalcium Phosphate Dihydrate (DCPD) is a potential precursor for producing the hydroxyapatite in a physiological pH medium. Its non-isothermal decomposition was investigated by simultaneous analysis TGA (DTG) / ATD to determine the most probable mechanism and to evaluate the kinetic parameters. The degradation process of DCPD phosphate showed a very complex mechanism which involves several decomposition reactions. The activation energy of each reaction step was therefore determined as a function of temperature and conversion degree using the isoconversional method "free model". Kinetic modeling describing the degradation process was performed by the Malek method and according to the concept of non-linear regression in order to determine the kinetic parameters (reaction order and pre-exponential factor). Based on theory of activated complex, the correlation between the OH vibrational frequencies observed in IR spectroscopy and experimental data from thermal analysis was performed to justify the proposed models.

Keywords: Di-calcium phosphate dihydrate, Thermal analysis, Decomposition reactions, Isoconversional method.

Photovoltaic Panels Tilt Angle Optimization -Case Study for Ifrane, Morocco

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The performance of PV systems strongly depends of the orientation of the panels, known as the azimuth angle, and the tilt angle of the collector's surface with respect to the horizontal, because both the orientation and the tilt angle determine the amount of solar radiation reaching the inclined surface of the collector. We examine the theoretical aspects that determine the optimal tilt angle and make recommendations on how to increase the solar energy collected by just varying the tilt angle. A mathematical model is developed to calculate solar radiation on an inclined surface as a function of the tilt angle. Our calculations are based upon the values of daily global radiation on a horizontal surface in Ifrane, Morocco. We assume the PV panels to be facing the equator (south). Our study shows that the monthly optimal tilt angle allows maximum solar radiation collection. We also show that optimal solar radiation collection is approximately achieved if the tilt angle of solar collectors is seasonally adjusted. Annual optimal tilt angle is found to be approximately equal to the latitude of the location. There is an energy loss of about 7.26 % when using the yearly fixed angle instead of the monthly optimal tilt angle. This loss is reduced to only 1.25 % if the seasonal optimal tilt angle is adopted instead of the monthly optimal one.

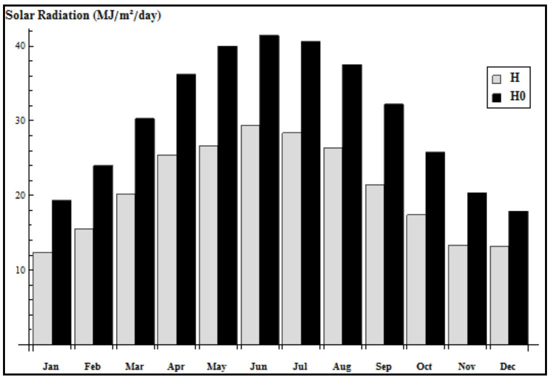

Fig. 1. Monthly average daily global solar radiation and monthly average extraterrestrial daily radiation on a horizontal surface in Ifrane.

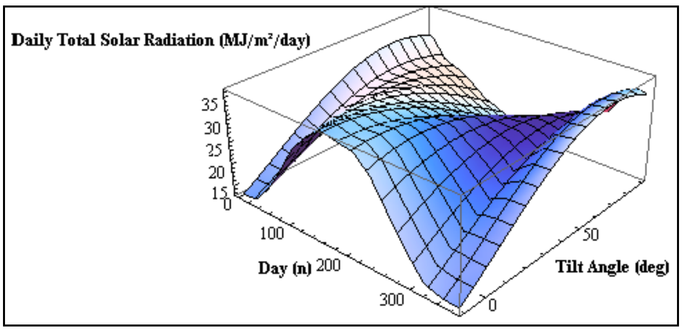

Fig. 2. Daily total solar radiation with respect to tilt angles and day of the year

Photo-Induced Electron Spin Resonance Phenomena in α-Cr_2O_3 Nanoparticles

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Keywords:
Phototoinduced phenomena, phase transition, ESR, Chromium(III) oxide, nanoparticles.

Photo-induced phenomena including phase transition and surface photo-activation are becoming a hot topic in the light-matter interaction domain and are of a specific interest both from fundamental and technological viewpoints [1-16]. Such a trend which is opening a multidisciplinary field by itself is unlocking new perspectives within which one could manipulate the physical properties of materials by photons and create new phases that cannot be reached through the quasi-thermal-equilibrium path [1]. Some studies have been reported in charge transfer complexes [2], halogen bridged metal complexes [3], and perovskite type oxides [4-6]. A singular specificity to these photo-induced phenomena is their dynamic in the ultrafast temporal regime in the various spectral ranges. This contribution reports on the photo-induced phenomenon in α-Cr_2O_3 mono-dispersed spherical particles. An X-band ($\nu \approx$ 9.75 GHz) electron-spin resonance (ESR) spectrometer was employed to investigate the magnetic behavior in α-Cr_2O_3 under the IR illumination of $\lambda\sim$ 1064 nm and a pulse repetition frequency of 30Hz in the nanosecond regime. The light photo-induced ESR signal appears above 280 K in the high magnetic field and is remarkably enhanced around T~300 K. Such a photo-induced ESR phenomenon disappears in a reproducible way in the *paramagnetic* insulating *state* which occurs *above the Néel temperature* (T_N) of α-Cr_2O_3. In the antiferromagnetic phase below T_N, the shift of the low field absorption could be attributed to the interaction of the light with specific Cr^{3+} ions located in strongly distorted sites correlated to strong ligand-field effect.

1. K. Nasu, Ed. “Relaxations of Excited States and Photoinduced Structural Phase Transitions”, Springer Series in Solid State Science Vol. 124, Berlin: Springer-Verlag, 1997.
2. S. Iwai, S. Tanaka, K. Fujinuma, H. Kishida, H. Okamoto, and Y. Tokura, Phys. Rev. Lett. 88, 057402, 2002.
3. S. Iwai, M. Ono, A. Maeda, H. Matsuzaki, H. Kishida, H. Okamoto, and Y. Tokura, Phys. Rev. Lett. 91, 057401, 2002.
4. T. Ogasawara, T. Kimura, T. Ishikawa, M. Kuwata-Gonokami, and Y. Tokura, Phys. Rev. B 63, 113105, 2001.
5. M. Fiebig, K. Miyano, Y. Tomioka, and Y. Tokura, Appl. Phys. B 71, 211, 2000.
6. S. Tomimoto, S. Miyasaka, T. Ogasawara, H. Okamoto, and Y. Tokura, Phys. Rev. B 68 035106, 2003.
7. E. Collet, Science 300, 612, 2003.

Z-Scan & Optical Limiting Properties of Natural Hibiscus Sabdarifa Dye

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Keywords:
NLO, Z-scan, optical limiting, intensity-dependent refractive index, nonlinear susceptibility, natural dyes, Hibiscus Sabdariffa Roselle.

Abstract
Similarly to the so called poled organic materials which are asymmetric organic molecules with a large molecular hyperpolarizability due to their electron delocalization along the conjugated backbone [1], specific natural dyes have been found to exhibit very attractive nonlinear optical (NLO) characteristics with nonlinear coefficients 10^4–10^6 times higher than that of CS_2. This natural dye family includes Chlorophyl, red Carmine, Chinese tea and betanin, Hibiscus Sabdariffa as well as, recently, functionalized DNA [2-5]. Concerning the Hibiscus Sabdariffa dye which is of the focus of this contribution, its NLO characteristics are due to the high population of delocalized p-electrons within their anthocyanin squeleton leading to a large 3rd harmonic generation and two-photon absorption phenomena including the appealing intensity dependent refractive index and optical limiting as it will be confirmed in this contribution. The intensity-dependent refractive index n_2 and the nonlinear susceptibility $\chi^{(3)}$ of Hibiscus Sabdariffa Roselle natural dye solutions in the nanosecond regime at 532 nm are reported. More precisely, the variation of both n_2 and $\chi^{(3)}$ versus the natural dye extract concentration has been carried out by Z-scan and optical limiting techniques. The third-order nonlinearity of the Hibiscus Sabdariffa dye solutions was dominated by nonlinear refraction, which leads to a strong optical limiting.

1. *Z. Sekkat & M. Dumont, Appl. Phys. B. 45, pp.486-9 (1992).*
2. *B. Kouissa, K.Bouchouit, S.Abed, Z.Essaidi, B.Derkowska and, B.Sahraoui, Optics Communications, online (2012).*
3. *F. Z. Henari and A. Al-Saie, Nonlinear and Quantum Optics-Laser Physics, Vol. 16, No. 12, pp. 1664–1667 (2006),*
4. *H. J. Zhang, J. H. Dai, P. Y. Wang, and L. A. Wu, Opt. Lett. 14 , 695 (1989).*
   R.Uma Maheswari, H. Kadono, T. Jaaskelainen, Optics & Laser Technology, Volume 26, Issue 2, Pages 136 (1994).
5. *A. Thankappan , S.Thomas , and V. P. N. Nampoori, J. Appl. Phys. 112, 123104 (2012).*

Optical Limiting in Femtosecond Mott Transition VO_2 Nanophotonics

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Keywords:
Vanadium dioxide, Phase transition, Refractive index modulation, Infrared, Optical limiting, Femtosecond regime.

Within the thermochromic vanadium based family there are several optically active vanadium oxides among which VO, V_2O_3 and VO_2. These later oxides are known for their metal/insulator–semiconductor (M/I–S) phase transition characteristics and hence exhibiting effective changes in their electrical resistivity at specific temperatures [1-2] which make them optically active under temperature/photo external stimuli. One should single out vanadium dioxide "VO_2" which exhibits a singular ultrafast 1st order type phase transition at the vicinity of about ~67.8 °C with several orders of change in the electrical resistivity due to its strong electron correlation. Such a large electrical resistivity modulation as a function of temperature is accompanied by a reversible semiconductor–insulator to metal transition. This latter behavior causes noteworthy reversible changes in the optical response, specifically in the infrared region with a consequential reversible modulation in the refractive index. This singular modulation of VO_2 makes it an optical coating candidate of choice for smart windows applications, thermal sensors, optical switching devices, field effect transistors and electro-optical gates as well as ultrafast tunable nano-plasmonics among others [3-10]. This contribution reports on ultrafast optical limiting of pulsed laser deposited VO_2 nanostructures in the IR spectral region; more specifically at 1.064 μm.

1. F.J. Morin, Physical Review Letters 3 (1959) 34.
2. K. Okimuram, N. Kubo, Japan Journal of Applied Physics 44 (36) (2005) 1150.
3. C.G. Granqvist, Handbook of Inorganic Chromogenic Mats., Elsevier, 1995, and references therein.
4. M. Maaza, K. Bouziane, J. Maritz, Optical Materials 15 (2000) 41.
5. A. Cavalleri, Cs. Toth, C.W. Siders, J. Squier, F. Raski, J. Kieffer, PRL. 87 (2001) 237401.
6. M. Maaza, C. Sella, B. Baruch-Barak, N. Ouassini, A. Beye, Optics Communications 254 (2005) 188.
7. M. Maaza, N. Ouassini, C. Sella, A.C. Beye, Gold Bulletin 38 (2005) 3.
8. S. Chen, H. Ma, X. Yi, H. Wang, X. Tao, M. Chen, X. Li, C. Ke, Infrared Physics & Technology 45 (2004) 239.
9. I. Balberbg, S. Trokman, Journal of Applied Physics 4 (1975) 2111.
10. A. Tselev, E. Strelcov, I. Luk'yanchuk, Nano Letters 10 (2010) 203.

Anderson Localization In Ship-Shaped CNTs

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Keywords:
Anderson localization phenomenon, Carbon nanotubes; attenuated total reflection; optical resonance cavity; infrared spectroscopy; multiple scattering and random media.

Within this contribution and based on the reported experimental interference phenomenon originating from straight or so called ship-shaped CNTs, we conjecture on the possibility of electromagnetic waves trapped in a resonating mode within the free space in the longitudinal central part of the CNTs. Such an optical trapping process of electromagnetic waves in such nano-cavities with a significant shape anisotropy is not infrequent. One should mention for instance, the lasing effects which have been recently observed in single nanowire cavities of CdS and GaN in addition to ZnO as reported recently [1-7]. The efficiency of this lasing phenomenon, due to excitonic formations, is governed by the nanowire spatial configuration itself too. Unlike quantum wells, these nanowires require no additional waveguide because they provide not only the gain but also waveguiding. These results on CdS, GaN and ZnO suggest that the two end facets of nanowires functions as two reflectors for guided waves and form a Fabry-Perot cavity. This contribution reports on Anderson localization phenomenon in ship-shaped CNTs by IR attenuated total reflection. Within such a geometry, the ship-shaped CNTs operate as an ensemble to form a laser type cavity even being a random system as predicted by Anderson in the case of electron wave-packets [6] and observed experimentally in random ZnO nano-powder [4].

1. Iijima, S. (1991) 'Helical microtubules of graphitic carbon', Nature, Vol. 354, p.56.
2. Agarwal, R., Barrelet, C.J. and Lieber, C.M. (2005) 'Lasing in single cadmium sulfide nanowire optical cavities', Nano Lett., Vol. 5, No. 5, p.917.
3. Johnson, J.C., Choi, H.J., Knutsen, K.P., Schaller, R.D., Yang, P. and Saykally, R. (2002) 'Single gallium nitride nanowire lasers', Nat. Mater., Vol. 1, pp.106–110.
4. Cao, H., Xu, J.Y., Zhang, D.Z., Chang, S.H., Ho, S.T., Seelig, E.W., Liu, X. and Chang, R.P.H. (2000) 'Spatial confinement of laser light in active random media', Phys. Rev. Lett., Vol. 84, No. 24, p.5584.
5. Maslov, A.V. and Ning, C.Z. (2003) 'Reflection of guided modes in a semiconductor nanowire laser', Appl. Phys. Lett., Vol. 83, p.1237.
6. Anderson, P.W. (1958) 'Absence of diffusion in certain random lattices', Phys. Rev., Vol. 109, No. 5, p.1492.
7. Maaza, M., Mhlungu, T. Ndwandwe, M.O., Cingo, N., Beye, A.C., Govindaraj, A. and Rao, C.N.R. (2007) 'On the possible optical resonance in carbon nanotubes based cavities', Int. J. Nanotechnol., Vol. 4, No. 6, pp.638–650.