ARW SMECS

NATO Advanced Research Workshop

Smart Materials for Energy, Communications and Security

ARW SMECS is co-sponsored by:

Office of Naval Research Global

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Faculty of Science and Technology

Inside Network

Maghrebian Electronic Materials

ARW SMECS Proceedings

ACI VOLUBILIS

French Ministry of Foreign Affairs

Marrakech, Morocco
13 -15 December 2007

Dear Colleagues,

Thank you for your participation in the NATO Advanced Research Workshop "Smart Materials for Energy, Communications and Security". This is not a conventional scientific conference but the meeting of the internationally leading material science experts having the **objective** to ensure their contact with colleagues from Morocco and other Maghreb countries with the main focus to review and stimulate the exploration of these emerging technologies and materials in academic and HT-industrial institutions of Maghreb.

ARW SMECS is provided and sponsored by the *NATO for Peace and Security Program* in frame of the Mediterranean Dialogue project. Rapid development of the West-East trade, cultural and human relations, and global processes of industry delocalization require the qualitative and quantitative enhancement of the collaborative links in the area of high-technology (HT) exploration, including the transfer of know-how, restructuration of basic research and educational networks. Because of its geopolitical situation, advanced research and educational infrastructure, Morocco serves as the key point of the HT- implementation in the countries of Mediterranean Dialogue (MD).

Accordingly, our Workshop has the purpose to encourage the creation of following collaborative links in the material research area: *NATO-MD*: technology and R&D transfer, *MD-MD*: installation of the horizontal inter-Maghrebian peer-to-peer and tutorial (like Morocco - Mauritania) collaborations, *NATO-NATO*: interaction and information exchange.

The principal topics of *ARW SMECS* are related either with the already implemented or with potentially perspective for MD countries materials and technologies

- Materials for Environmental Security
- Photovoltaic, Solar Energy, Energy Storage
- Electroactive materials
- Materials for Emerging Technologies
- Telecom Materials and Technologies

History: *ARW SMECS* is an important stage of the long-term collaboration project between Participating Institutions.

Started in 90s, the Organizer's collaboration in the area of Electroactive Materials was supported in 2003 by the NATO Collaborative Linkage Grant. In 2004 we created the research network "Moroccan Electronic Materials" (*MEM*) (www.reseau-MEM.org) that was the natural continuation of the NATO Linkage Grant. The first congress of *MEM*, (70 Moroccan+7 European participants), was organized in 2005 in the young Saharian University of ErRachidia. Then, the International Meeting on Materials for Electronic Applications - IMMEA-2007 (more then 200 participants from 16 countries) was organized in Marrakech in May 2007. The large number of collaboration research projects on the bi- and multilateral level (like e.g. Foreign Affairs Ministries ACI poject Volubilis between Amiens (France) and Marrakech) was started in the frame of the network *MEM*. The

network *MEM* stimulated also the joint Morocco-Europe co-oriented PhD thesis and high-level Professor habilitations. In May 2007 the important decision to orient the *MEM* structure to other Maghreb countries: Algeria, Tunisia, Mauritania was taken and the International Coordination Committee was designated. As the first step we program to organize the next MEM meeting in 2009 in University of Sfax, Tunis.

The important feature of ARW SMECS is the multidisciplinary that will allow to share the mutual interests and experience of participants, providing the interpenetration of ideas from different material research areas and from different activity fields. All the speakers are recommended to give a short overview of the place of their subject in the general stream of modern research and technology applications, the possibility to integrate their activity in the material research of MD countries, and the potential application of their materials for the environmental, civil and regional security applications.

Special session in format of Round Table will be devoted to the political overview of the current collaboration between NATO and MD countries, the expectations and understanding of the partners, and to HT transfer to the less developed countries, like Mauritania.

We believe that such format of Workshop will enhance the mutual understanding between NATO and MD partners and will be highly beneficial and stimulating for both sides. It will give an **important impact** on the further development of collaboration and stimulate an access to the joint research programs supported by national sources, EC (CORDIS), NSF and, especially by the NATO Program for Security Through Science.

We acknowledge here the political and research institutions that, together with NATO-for – Peace-and-Security-Program helped us to organize the ARW SMECS: Cady Ayad University of Marrakech, Office of Naval Research Global, UK; French and Moroccan Foreign Affairs Ministries (Program ACI VOLUBILIS), Springer Science Inc.

Trying to provide the best conditions, we wish you a productive and creative work during the Workshop and agreeable stay in the best orient town Marrakech!

The members of organizing committee,

the ARW SMECS Directors:

Igor Lukyanchuk,

Daoud Mezzane

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NATO advanced Research Workshop, Smart Materials for Energy, Communications and Security (SMECS)
Marrakech, 13-15 December 2007

PROGRAM

Wednesday, December 12, 18:00-20:00- Registration in Club O.N.E., welcome tea

	Thursday, 13 December	Friday, 14 December	Saturday, 15 December
9:00	**- opening**	Chair: W. Kleemann **- SIGOV, A.S.** (Moscow, Russia) Ferroelectric Nanostructures: Preparation and Applications	Chair: P. Saint-Gregoire **- Aline ROUGIER** (France) Electrochromic devices in infrared region
9:40	Chair: DI CARLO. A **- BENAISSA M**.(CNRT, Morocco) Strategy of CNRT in research development in Morocco	**- SAYOURI S.** (Morocco) Magnetic and anisotropic properties of the Co/Pt ultra-thin films	**Focus session: Mauritania** **- OULD EL BAH, M**. (Mauritania) Research in Mauritania and International collaboration
	10:10 –10:50 Coffee Break		
10:50	Chair: A. Kavokin **- YAZAMI. R**. (CalTech, USA) Nanomaterials for electrochemical energy storage and conversion	Chair: M. Popescu **- KOPELEVICH Y**. (UniCamp, Brazil) Perspective of using graphite in semiconducting technology	Chair: M. Benaissa **- KADRI A.** (Alger, Oran) ZnO-Based devices & applications
11:30	**- KLEEMANN W**. (Duisburg, Germany) Magnetoelectric and multiferroic materials for spintronics	**- CASANOVE M. -J.** (CEMES, France) TEM analysis of electronic devices : from structure to properties	**- GIL Bernard** ; (Univ. Montpellier,FRANCE) Group III nitrides: from IR solar cells to UV LEDs applications
12:20	**- BRATKOVSKI A.** (Hewlett-Packard, USA) Spintronics and plasmonics for nanoelectronics in 21st century	**- ELOUADI Brahim** (La Rochelle, France) Quantum Interaction of nano-entities in zeolite channels	**- DI CARLO Aldo** Organic and hybrid organic/inorganic photovoltaic cells
	13:00 –15:00 Lunch		
15:00	Chair: BIH L. **- SAINT-GREGOIRE P.** (Univ.Toulon, France) Solar Energy: North to South collaboration	Location: club O.N.E **Round Table 1** **Europe – Maghreb** R. Farhi, J. Kobielski, V. Agarwala, A. Kavokin, A. Sigov, P. St. Gregoire,... (Animated by A. Bratkovski)	Chair: A. Sidorenko **- KAVOKIN A**. (Southampton, UK) GaN-based microcavities for the new light sources
15:30	**- SCOTT. J. F, CATALAN G.** (Cambridge, UK) Science and technology of ferroic and multiferroic nanodevices		**- POPESCU Mihai,** ROMANIA Amorphous chalcogenide materials with smart memory
16:00	**-El MOUDEN**. (Morocco) Quality control by ultrasound techniques		**- KALLEL Ali,** (Tunis) Dielectric properties of PZT piezocomposits
	16:30 – 17:00 Coffee Break		**- closing**
17:00 17:40	Chair: H. Khemahem **Focus session: Egypt** **- INAS Kamal Battisha, . MOSTAFA Amany** (Egypt) Development of Nano-Structure Materials and their characterization	**Round Table 2** **Maghreb – Europe** I. Luk'yanchuk, D. Mezzane, M. Benaaissa, Ould ElBah, Zayer E, Maalej A, Kadri. A. .....(Animated by B. Ellouadi)	**Beverage free exchange of impressions**
18:50	Chairs: Y. Gagou, M. ElMarssi **Poster Session**	**Conference Dinner**	

Sunday, 16 December, full-day bus excursion to Essaoira

POSTERS

Vortex lattices in exciton-polariton condensates: excitation and dynamics
Yuri G. Rubo, T. C. H. Liew, A. V. Kavokin

PKN Thin films
Gagou Y., Mezzane D., Amira Y.

Structural properties and electrical behaviour in the polycrystalline lanthanum-deficient manganite La1-x _xMnO3
R.Dhahri , M. Bejar, K. Khirouni , F. El Halouani and E. Dhahri

X-RAY DIFFRACTION, DSC AND OPTICAL MEASUREMENTS OF [C8H9N2]3BiCl6.H2O
Ikram Baccar, Habib Feki, Younès Abid and Fatma Zouari .

Synthèse, étude structurale et transition de phase du quinolinium tetrabromothallate (III)
Najla Chaari , Slaheddine Chaabouni et Abdelhamid Ben Salah

X-ray Powder Diffraction and Electrical Studies of NdSrCr0.5Ni0.5O4-δ;
Manel JAMMALI, Hanen CHAKER, Kamel CHERIF and Rached BEN HASSEN

X-ray powder diffraction study on BaTi0,975(Zn1/3Nb2/3)0,025O3 solid solution
L. Khemakhem, A. Kabadou, A. Ben Salah and A. Simon.

Hall effect measurements of insulating n-type CuInSe2 single crystals between 4.2 and 300 K in pulsed magnetic field up to 35 tesla.
L. Essaleh ; S. M. Wasim

Sol-gel synthesis of tin dioxide destined for gas monitoring application
M. AMJOUD, B. RHOUTA, A. ALIMOUSSA, D. MEZZANE, L. HAJJI

Terahertz Applications of Carbon Nanotubes
M.E. Portnoi, O.V. Kibis and M. Rosenau da Costa

Dynamics of spin excitations in diluted magnetic semiconductors
M. Vladimirova, P. Barate, S. Cronenberger, D. Scalbert, A. P. Dmitriev

Magnetocaloric effect in electron doped manganite La1-xCexMnO3
S. Othmani, M. Bejar, E. Dhahri andE.K. Hlil

Simulation tools for physical simulation of electronic devices
L. Baudry, M. Charef, C. Dalle, F. Dessenne and J.L. Thobel

Structural and electrical studies of Pb2(1-x)GdxK(1+x)Nb5O15 ceramics
Amira Y., Gagou Y. , Elmarssi M., Mezzane D. , Zegzouti A. and Elaatmani M.

NbF5 ADDITION FOR REDUCED HYDROGEN DESORPTION TEMPERATURE OF BALL-MILLED MgH2
Aline Rougier, Nadir Recham, Manickam Kandavel, Vinay V. Bhat, Luc Aymard, and Jean-Marie Tarasco

Nb Nanolayers with Advanced Superconducting Properties and SF-Nanostructures for Superconducting Spintronics
A. Sidorenko, V. Zdravkov, A. Prepelitsa, R. Morari

Filters for THz radiation
M.Kaliteevski, A.Gallant, S. Brand, D.Wood, M.Petty, R.A. Abram, and J.M.Chamberlain

Clays and clay minerals in High Atlas of Marrakech
Daoudi Lahcen et Rhouta Ben Aissa

New method for preparation of polycrystalline langasite La3Ga5SiO14 : structural studies
Abdeljalil BENLHACHEMI , Khalid OUZAOUIT , Sylvie VILLAIN, Houria BENYAICH, Jean-Raymond GAVARRI

HIGH-QUALITY SUPERCONDUCTING MgB2 FILMS FOR MICROELECTRONICS
A. Sidorenko, V. Zdravkov, A. Surdu, Th. Koch, Th. Schimmel

Helical nanostructures and Aharonov-Bohm rings in a transverse electric field
M.E. Portnoi, V.L. Campo Jr, M. Rosenau da Costa, L. Huggett, O.V. Kibis

Pyroelectric properties of PMNT-Single Crystals
Es-Souni, Dietze, Hao-Su Luo, Neumann, Elouadi

Universal Properties of Ferroelectric Domains in Thin Ferroelectric Films
A. Sene, L. Lahoche, I. Lukyanchuk

Electrical properties of nano-crystalline $LiCoO_2$ cathode material .
M. Yahia, I. Saadoune, A. Almaggoussi, A. Abounadi, A. Outzourhit

Characterization of structure defects in nanocrystalline copper prepared by high energy mechanical milling
Mohamed Khitouni, Rakia Daly, Mohsen Mhadhbi, Abdelwaheb Kolsi, A. Kabadou

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF Cua1COPPER PROCESSED BY EQUAL CHANNEL ANGULAR EXTRUSION
Rakia Daly, Nabil Njeh, A. Kabadou

ABSTRACTS

National Technical platforms of CNRST; mission and perspective

Mohammed BENAISSA

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In the frame of the 2000-2004 government development-plan, the CNRST created the so-called UATRS (www.cnrst.ma/uatrs/) which are technical platforms open to the Moroccan scientific community in universities, in specialized centers and in small/medium Enterprises and Industries. Operational since January 2005, UATRS platforms are currently composed of about 13 laboratories that include chemical analyses, materials characterization, and molecular biology diagnostics. Because of the high cost of this heavy infrastructure, either at the purchase stage or during its use and maintenance, the CNRST decided to regroup all the equipments in one site and to promote thereby the culture of mutual use of expensive and sophisticated instrumentation. It also has the advantage of producing complementary results which is usually a fundamental and a strongly recommended approach for state-of-the-art scientific research. In addition, UATRS platforms provide : assistance to researchers, to producers, and to decision makers, outstanding services due to a highly qualified personnel and full respect of intellectual property and confidentiality a wide variety of application fields including physics, metallurgy, ceramics, microelectronics, geology, biochemistry, biology, medicine, biomaterials, chemistry, pharmacology, etc. the possibility to technology developers to maximize their chance of success and therefore achieve their objectives a strong contribution to Research training due to highly experienced scientists. Finally, UATRS are currently preparing an ISO accreditation since this later proves to be a precious tool which facilitates and accelerates national/international exchanges in nowadays open economy.

Magnetoelectric and multiferroic materials for spintronics

Wolfgang Kleemann

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Purely voltage controlled multiferroic and magnetoelectric materials promise to fulfill the requirements of minimal heat dissipation in three-dimensional spintronic architectures. Actually, most promising concepts aim at electrically controlling the giant or tunneling magnetoresistance of magnetic multilayer stacks involving either magnetoelectric [1] or multiferroic tunnel barriers [2] or exchange-coupled magnetoelectric pinning layers [3]. The physical principles and the state of the art of these concepts will be discussed for devices involving $La_{0.1}Bi_{0.9}MnO_3$ tunneling barriers [2] and Cr_2O_3 pinning layers [4].

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[2] M. Gajek et al., Nature Mat. 6, 296 (2007)
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Nanostructures and plasmonic metamaterials

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We give an overview and outlook for research into functional nanostructures, with an emphasis on nanostructued metamaterials that are shown to perform in the optical range. We have recently designed and tested metal-oxide and metal-semiconductor metamaterials heterostructures (having fishnet architecture) that exhibit a negative index behavior in the optical range. Moreover, the effective index can be tuned over a significant range of values. We shall touch upon other excititng topics, like plasmonic lenses and other plasmonic structutres with enhanced performance.

Challenges in materials and devices for alternative energies ; from low to high technology

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The problem of energy is strongly dependent on the concerned population and location in the world, whereas research in the field of renewable energy concerns mainly high technology, and hence expensive, devices and materials. The aim of this paper is to give a review of materials and devices for solar energy, that are used in different places (from the poorest ones to the most developed), and to analyse challenges, strategies of development, difficulties, and perspectives associated with the need of intensification of the use of alternative energies in next decades.

Science and technology of ferroic and multiferroic nanodevices

Gustau Catalan and James F. Scott

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Ferroic and multiferroic materials cover a wide range of functionalities and applications, from ferroelectric memories and piezoelectric actuators to magnetic sensors and bi-tunable devices. These functionalities, however, are not always easy to export to the nano-scale. This talk will cover some of the technical challenges ahead in the race towards miniaturisation of ferroic devices, and some of the interesting emerging physics of ferroic materials at the nanoscale. Particular emphasis will be placed on 3-d nanostructures, domain morphology and switching phenomena.

DEVELOPMENT OF NANO-STRUCTURE ADVANCED MATERIALS AND THEIR CHARACTERIZATION.

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With introduction of internet super highway and increased demand for broadband data transmission, there is an ever-increasing need for high performance and reliability, low cost and small form factor components to serve metropolitan and local area networking. These components include couplers, splitters, tunable lasers and optical amplifiers. The objective of this lecture is meet these demand by development of some nano-structure materials that can help in producing these components using the sol-gel process, which is well known to be a low temperature and cost effective process. Silica – titania glasses have been widely investigated for sol gel preparation of integrated wave-guides and up-conversion applications. Efficient infrared –to– visible conversion by Er^{3+}: Yb^{3+} and Nd^{3+}: Yb^{3+} co-doped 90 wt % SiO_2-10 wt % TiO_2 nano-composites fabricated by spin coating sol-gel route will be reported. The process is observed under 808 nm laser diode excitation and results in the generation of green (526 & 550 nm) and red (650 nm) emissions for the former and blue (478 nm) and green (513 & 580 nm) emissions for the later. The main mechanism that allows for up-conversion is attributed to the energy transfer among Nd^{3+} and Yb^{3+} ions in excited states. The power of up-conversion efficiency for red emission is predominant in sample doped with Nd^{3+}: Yb^{3+} material. The results illustrate the large potential of this class of materials for photonic applications involving optoelectronics devices.

Keywords: Spin coating sol-gel technique, thin film, up-conversion, XRD, SiO_2:TiO_2 nano-composite, and Nd^{3+}: Yb^{3+} ions.

Materials for Biomedical Applications

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Materials research has recently directed its focus towards biomaterials. A biomaterial is any material, natural or man-made, that comprises whole or part of a living structure or biomedical device which performs, augments, or replaces a natural function. Undoubtedly, biomaterials have had a major impact in improving the quality of lives of humans and animals. Their range of applications continues to grow. In addition to traditional medical devices, diagnostic products, pharmaceutical preparations, and health care disposables, now the list of biomaterial applications includes smart delivery systems for drugs, tissue cultures, engineered tissues, and hybrid organs. To date, tens of millions of people have received medical implants. There are numerous researches focusing on novel biomaterials for use in matrix manufacturing. These Materials include synthetic polymers, ceramics, natural polymers, and their composites. A bone tissue-engineered scaffold is typically biodegradable and osteoconductive. The desired mechanical properties vary according to wound site. The challenge is to create a biocompatible material that will degrade at a complementary rate to bone formation, with minimal foreign body response. When trauma occurs affecting the bones, fractures and bone loss may be an added complication. Surgery is often needed to stabilize the area. Healing may be delayed. Bone grafts can be used to help fill in gaps and speed up the process. Our review focuses on the bone substitute and bone graft substitute materials. There are several different types of chemical compounds on the market. Studies to compare them are very limited. For now, the surgeon is on his or her own to know about each one and to choose the best product for each patient.

Ferroelectric and multiferroic thin films and nanostructures for nano- and optoelectronics

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Fabrication, structural and functional properties of epitaxial thin films, nanostructures and photonic crystals of ferroelectric $BaSrTiO_3$ (BST) and multiferroic Nd-dolped $BiFeO_3$ (NBFO) are reported. Both materials possess extraordinary functional properties (polarization and magnetization) which are even enhanced due to nanostructuring. Potential applications of the obtained materials in nano- and optoelectronics are discussed.

Structural and dielectric characterizations of hydrothermally processed PLZT ferroelectric relaxor

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$(Pb_{1-y}La_y)(Zr_{0.52}Ti_{0.48})O_3$ ($PLZT_y$) powders where y = 0, 0.015, 0.03, 0/06, 0.08, 0.10, 0.12, 0.15 and 0.20 were prepared using hydrothermal process and their structural and dielectric properties investigated. Increasing La content is shown to enhance crystallization of the raw samples and to transform the average symmetry to tetragonal one in the calcined ones. Two anomalies are observed on the real part of the permittivity on both undoped and doped samples, at relatively high temperatures (~ 180 °C; ~ 260 °C). The anomaly located at about 180 °C was interpreted as a transition from ferroelectric-rhombohedral phase to ferroelectric-quadratic phase. A polynomial law was used to fit the thermal behavior of the permittivity.

Keywords: PLZT; Dielectric anomalies; Relaxation, MPB

Perspective of using graphite in semiconducting technology

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Single layers of carbon dubbed "graphene", from which graphite is built, have attracted broad interest in the scientific community because of recent exciting experimental results. Graphene is interesting from a fundamental research perspective, as well as for potential technological applications. Here, we provide a brief overview of recent developments in this field, focusing especially on the electronic properties of graphite. Experimental evidence indicates that high-quality graphite is a multi-layer system with nearly decoupled 2D graphene planes. Based on experimental observations, we anticipate that thin graphite samples and not single layers will be the most promising candidates for graphene-based electronics.

TEM analysis of electronic devices: from structure to properties

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During the last decades, TEM has become an essential tool for solving problems involving microstructural questions in Materials Science. Its unique ability to provide direct imaging of particular regions of the material together with structural information made it particularly valuable in the study of complex materials including domains as ferroelastic materials. Moreover, TEM is the dedicated technique for studying defects (dislocations, boundaries, precipitates...), which can either affect or enhance the desired properties (mechanical, optical or magnetic properties, transport). TEM analysis is even more essential now with the advent of nanotechnology. We will show that today's studies on nanomaterials for energy, communication or security will benefit from TEM analyses, not only for nanostructural characterization but also because new developments in TEM now allow us to determine various fields in the specimens, in particular strain fields, which bring direct information on the physical properties.

COMPARATIVE STUDY OF THE QUANTUM INTERACTIONS OF NANO-SIZED ENTITIES INSERTED IN THE ZEOLITHE CHANNELS

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Different experiments have evidenced a direct correlation between the size of the samples and the measured physical properties in various systems. Many investigations are currently carried out in order to give a reasonable interpretation for such correlation [1-6]. The physical models for many properties (optical absorptions, emissions, ferroelectric transitions, piezoelectric behaviour, etc.) have been elaborated on the basis of the atomic architecture of bulk single crystals (or large size grain ceramics) and band structure (or doping impurity levels) for the energetic aspects. When the division state of matter becomes of the nanometre scale, the bulk properties do not seem to be recognized and it appears like if new physics is appearing!! For example it well established on single crystals and using classical grain size ceramics that the pure phase $BaTiO_3$, is ferroelectric with a tetragonal crystalline system at room temperature. Various studies [3-4] have shown that the "tetragonality" of the latter phase tend to disappear as the grain size decreases below a critical dimension. It then appears the question of the meaning of the ferroelectric phase of barium titanate at room temperature. This will be discussed in the perspective of the correlation between the chemical composition, the structure and the physical properties. In the same continuation the structure of various nano-sized entities (as characterized by EXAFS) will also be discussed and particularly the forms that we have succeeded to incorporate inside the channels and cavities of meso-porous lattices of zeolites [5-6]. We will more specifically analyse the cases of: i) Se-incorporated Na-mordenite, which seem to behave like nano-wires; ii) ZnO-like quantum dots in LTA and sodalite zeolites. The type of interaction with the host lattice will tentatively be modelized.

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TOWARDS ELECTROCHROMIC DEVICES ACTIVE IN THE INFRARED REGION

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In the past few years, electrochromic devices, which show change in their optical properties under applied voltage, have received a great attention in respect of their promising potential in the defence area. In particular, the preparation of coatings for vehicles and persons, which would be able to blend into their surrounding under an external stimulus and, therefore become invisible to an infrared camera is highly desirable. Such property requires an electrochromic device, with a good memory, and which rapidly and reversibly switches from 80 to 40% in infrared emissivity in particular in the atmospheric transmission windows called the MW band (mid-wavelength 3-5 μm) and LW band (long wavelength 8-12 μm). In this presentation, all-solid-state devices will be suggested in respect of the position and the thickness of the WO_3 electrochromic layer. Based on a combination of experimental and modelling approaches, the choice of the counter electrode as well as of the electrolyte will be particularly discussed in respect of the highest contrast in reflectance of the full WO_3 based electrochromic devices in the IR region.

ZnO-based devices and applications

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Wide bandgap II-VI ZnO-related materials and devices are gaining much interest in recent years, due to their various and very rich set of properties which make them potential candidates in various applications. Indeed, ZnO can be combined with MgO as $Mg_xZn_{1-x}O$ and with CdO as $Zn_{1-y}Cd_yO$ to span a very interesting range of energy gaps lying $3eV<E_G<4eV$. ZnO-related materials are in many aspects very similar to their corresponding III-V nitride materials as GaN, AlGaN, and InGaN. However, they are thought to be much more promising, because they not only show additional properties, but they are more abundant, less expensive, less toxic and easier to synthetise. They are promising in various applications as : in High power and high speed electronics, working in hostile environment, in Highly resistant, Long duration Opto-electronics LED's and Lasers, in Piezo-acoustic and Piezo-electric devices used in detection and signal processing, in Chemical sensing and Pyro-elecric applications, in Nonlinear optics and Photonics, in Spintronics and Piezotronics applications, in nanoscale applications (nanowires, nanobelts, ..). There are however still pending issues such as in high quality crystal growth, and in p-type doping, although, some improvements have been reached in recently years.

Indium nitride quantum dots for advanced applications

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In the first part of the presentation, we review the growth of indiun nitride films and quantum dots by metal-organic vapour phase epitaxy. In the second part, we detail the influence of growth parameters on structural and fluorescence properties of such nanostructures. A a third one we discuss the application that are tergeted in relations with the optical properties of indium nitride based devices.

Organic and hybrid organic/inorganic photovoltaic cells

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Photovoltaic energy research is experiencing a renewed interest mainly due to the strong request for renewable energy sources. New technologies are now available to improve the photovoltaic conversion efficiencies and to reduce the system costs. Usually solar cells are based on inorganic semiconductors, mainly Silicon, following different architectures and realization processes. Standard semiconductor technologies provides good performances but can be expensive, both in terms of production and environmental issues. In order to reduce such realization costs, solar cells with organic materials have been demonstrated. Among all the organic and hybrid organic-inorganic solar cells, in particular dye sensitized solar cells (DSSC) have demonstrated the highest conversion efficiencies. In this presentation we will review the state of organic photovoltaic and recent developments at the Centre for Hybrid and Organic Solar Energy (CHOSE) which has been recently established in Italy to assist the transfer of organic photovoltaic technologies from research centres to industry.

Polariton lasers based on GaN

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Polariton lasers are coherent light emitters of a new generation. Contrary to the conventional lasers they do not require inversion of electronic population and have a very low threshold therefore. I will discuss the first polariton lasers based on GaN microcavities which have been fabricated in EPFL (Lausanne) and characterised at the university of Southampton (UK).

Amorphous Chalcogenide Materials with Smart Memory

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The state of art in the phase change memories based on amorphous chalcogenides is presented. The multistage memory is discussed. The structural modelling of the phase change materials including the last results in the explanation of the chalcogenide memories is given in details. The compounds based on germanium, antimony and tellurium are highlighted and their outstanding properties are evidenced. Finally the applications of the amorphous chalcogenide materials in electronics and informatics are shown.

Dielectric properties of PZT piezocomposits

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A series of 1-3 connectivity PZT fibres/epoxy resin composites with different volume fraction is studied by means of dielectric spectroscopy in the wide frequency range 0.1 Hz-100 kHz and temperature varying from the ambient to 210 °C. Ac conductivity data are analysed using the "universal power law" and its scaling is studied by the Jonscher's universal power law. At low frequencies ac conductivity tends to be constant, while in the high frequency region verifies the exponential law of conductivity. In the intermediate frequencies, the examined systems exhibit strong dispersion with frequency and the produced fitting curves deviate from the experimental data by not being able to describe the recorded relaxation and pointing out that in the vicinity of the relaxation peaks the power law is not applicable. Finally, dipolar relaxation mechanisms and interfacial or Maxwell-Wagner-Sillars relaxation were revealed in the frequency range and temperature interval of the measurements. These relaxation mechanisms were analysed using the electric modulus formalism.

Vortex lattices in exciton-polariton condensates: excitation and dynamics

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We study the dynamics of topological defects in coherently excited polariton condensates in planar semiconductor microcavities. Polariton condensates containing vortex lattices can be excited by three superimposed laser beams. Each beam generates polaritons with the same absolute value of the in-plane wave vector, but the three wave vectors are differently oriented and sum to zero. The resulting initial vortex configuration depends on the polarization of beams and is given, in general, by two differently oriented honeycomb lattices of half-vortices. The dynamics of vortex lattices is studied by the numerical solution of the Gross-Pitaevskii equation.

PKN Thin films

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$PbK_2Nb_5O_{15}$ thin films were elaborated by the PLD technique on two different substrates. These reveal a good crystalline quality with a c-axis preferential orientation. Electrical Measurements performed on these samples show their ferroelectric behaviour, with a low spontaneous polarization.

Structural properties and electrical behaviour in the polycrystalline lanthanum-deficient manganite $La_{1-x}\_{x}MnO_3$

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Electrical conductance and X-ray diffraction measurements of lanthanum-deficient polycristalline samples were performed to examine the effect of the internal pressure at B-site on the conduction mechanism. The structural study reveals that for all compositions, samples crystallize in the rhombohedral system. For all samples, the electronic conduction appears to be thermlly actived at high temperatures, which indicate the presence of a semiconductor behavior. The increase of x converts 3x Mn^{3+} ions to Mn^{4+} with smaller ionic radius, which reduces the internal pressure and leads to the increase of the one electron bandwidth W. This increasecauses the appearance of a metallic behavior at mow temperatures for 0.10 and 0.20 compositions.

X-RAY DIFFRACTION, DSC AND OPTICAL MEASUREMENTS OF $[C_8H_9N_2]_3BiCl_6.H_2O$

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The salt tris (2 amino-indolinium) hexachlorobismuthate (III) monohydrate crystallises at room temperature in the monoclinic system with space group P 21/n, the unit cell dimensions are: a = 15.1853(2), b = 11.7761(9), c = 17.3168(2) Å, β; = 103.937(8)°, with Z = 4. The structure has been refined to R = 0.0294. The structure shows a layer arrangement parallel to the b axis : planes of the $[BiCl6]_3$- isolated octahedra alternate with planes of 2 amino-indolinium cations. The cohesion forces of the packing of 2 amino-indolinium units in the layer and between two adjacent layers are provided by hydrogen bonds (N-H…Cl, O(W)-H…Cl) and van der Waals contacts. The title compound was characterized by calorimetric and optical measurements. DSC experiment reveal a transition at T = 443K (Phase I -;(443K) Phase II).

Synthèse, étude structurale et transition de phase du quinolinium tetrabromothallate (III)

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La synthèse et l'étude structurale du quinolinium tetrabromothallate(III) entre dans le cadre de l'investigation du système quaternaire Tl_2O_3-HBr-C_9H_7N-H_2O. Ce composé a été préparé par mélange dans les proportions stœchiométriques d'une amine aromatique et d'une solution d'oxyde de thallium (III) préalablement dissout dans l'acide HBr. La structure cristalline est déterminée par diffraction des rayons X sur monocristal. Ce composé cristallise dans le système orthorhombique de groupe d'espace Pna21. Les paramètres de maille sont les suivants : a = 9,582(2), b = 10,021(2), c = 14,916(2) Å, avec Z = 4 et R = 0,0452. La structure cristalline est constituée par des tétraèdres $TlBr_4$ isolés entre lesquelles s'intercalent des molécules organiques. La cohésion de l'édifice cristallin est assurée par des liaisons par pont hydrogène du type N-H…Br. Une étude enthalpique différentielle révèle la présence d'un pic endothermique vers 406 K, cette transition a été confirmée par des mesures diélectriques.

X-ray Powder Diffraction and Electrical Studies of $NdSrCr_{0.5}Ni_{0.5}O_{4-\delta}$;

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$NdSrCr_{0.5}Ni_{0.5}O_{4-\delta}$; had been prepared using sol-gel method then annealed in 1 atm of Argon gas flow during 6 days at 1200°C. X-ray diffraction measurements were performed and bond valence sums were calculated from the perspective of the Brown bond valence calculation theory. The sample had been shown to adopt the K2NiF4 type structure. The electrical resistivity measurements between 298 and 703 K show the existence of two anomalies at 493 and 573K. The resistivity has been fitted using the Arrenius equation. The effect of Cr^{3+} substitution on the structural and electrical properties of $NdSrNi_{0.5}Cr_{0.5}O_{4-\delta}$; are discussed in terms of the Jahn-Teller distortions in the local coordination of (Ni/Cr)-O octahedra.

X-ray powder diffraction study on $BaTi_{0,975}(Zn_{1/3}Nb_{2/3})_{0,025}O_3$ solid solution

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The crystal structure of $BaTi_{0,975}(Zn_{1/3}Nb_{2/3})_{0.025}O_3$, has been determined using X-ray powder diffraction technique. At room temperature, the title compound crystallizes in the tetragonal space group P4mm, with a lattice parameters a = b = 4.026 (4) Å and c =4.0091(4) Å. The Rietveld refinement of the structure leads to final confidence factors Rp = 0.0353 and Rwp = 0.0432. . The structure of the title compound belongs to the large family of $BaTiO_3$ related structures. Dielectric permittivity was measured in the temperature and frequency ranges, respectively, 80-500K and 0.1-200 kHz. The rhombohedral-orthorhombic and orthorhombic-quadratic perovskite transitions are characterised by two weak peaks but the tetragonal-cubic ferro-paraelectric one is characterised by a pronounced peak with frequency dispersion.

Hall effect measurements of insulating n-type $CuInSe_2$ single crystals between 4.2 and 300 K in pulsed magnetic field up to 35 tesla.

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The Hall coefficient RH of n-type $CuInSe_2$ single crystals is measured between 4.2 and 300 K in pulsed magnetic field up to 35 tesla. A two-band model with electrons in both the conduction and impurity bands is used to analyze the temperature dependence of electron concentration between 4.2 and 300 K at different values of the magnetic field. It is confirmed, as expected, that the density of states effective mass me* = 0.09 mo is independent of the magnetic field strength. It is found that above about 8 tesla, Ed and μc/μi, where μc and μi are the mobility in conduction and impurity bands, respectively, show a tendency to be proportional to B1/3. This field dependence is in agreement with the theory of Efros and Shklovskii for a positive magnetoresistance in the high magnetic field regime when the conduction is due to variable range hopping mechanism of Mott type. In addition, the width δ of the impurity band also seems to be proportional to B1/3. The coincidence in the field dependence of the magnetoresistance , Ed, μc/μi and δ in the high magnetic field regime suggests that more theoretical work that could correlate the magnetoresistance model with Ed, μc/μi and δ is needed.

Sol-gel synthesis of tin dioxide destined for gas monitoring application

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In this work, we have prepared SnO_2 gas sensors by the sol-gel method using $SnCl_4$ as a precursor. We studied the effect of preparation conditions (temperature and pH) on the microstructure (grain size) of the sensors and their sensitivities.

Terahertz Applications of Carbon Nanotubes

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We formulate and justify several proposals utilizing unique electronic properties of carbon nanotubes for a broad range of applications to terahertz (THz) optoelectronics, including THz generation by hot electrons in quasi-metallic nanotubes, frequency multiplication in chiral-nanotube-based superlattices controlled by a transverse electric field, and THz radiation detection and emission by armchair nanotubes in a strong magnetic field.

Dynamics of spin excitations in diluted magnetic semiconductors

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We study the dynamics of the spin excitations in CdMnTe quantum wells containing two-dimensional electron gas. The magnetic field strong enough to polarize Mn spins is applied in the plane of the QW structure and then a short light pulse excites the spins of both electron and Mn spin subsystems in the perpendicular to the field direction. The subsequent dynamics of the spin precession is recovered from the Kerr rotation of the probe pulse polarization, as a function of the pump-probe delay. Because the electrons are strongly coupled to the Mn ion spins via exchange interaction, we observe different kinds of collective spin excitations involving both magnetic ions and itinerant carrier spins. Under resonant condition, (the magnetic field is such, that the spin precession frequencies of electron and magnetic ions are equal), three types of the collective spin precession modes are observed. Two of these modes can be understood in the mean field approximation, they correspond to the collective precession of the average macroscopic spins of magnetic ions and carriers, respectively. The interpretation of the last mode requires going beyond the mean field approximation. We show that this mode is characterized by the equilibrium value for the electron spin, parallel to the magnetic field, and the values of the individual magnetic ion spins such, that the total exchange field created by the magnetic ions on the electrons is equal to zero.

Magnetocaloric effect in electron doped manganite $La_{1-x}Ce_xMnO_3$

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In this paper we are going to report different results found with $La_{1-x}Ce_xMnO_3$ (x=0,3; 0,4 and 0,5) manganite compounds, where La is substituted by Ce to obtain an electron doped manganite. Magnetic and magnetocaloric effect MCE were studied. We found that the Curie temperature decrease when the cerium content increase for a heating temperature of 1400°C. The MCE was measured according to Maxwell relation based on the magnetic measurement. Compared with hole-doped manganite those compounds exhibit a large MCE, so the studied samples could be considered as magnetocaloric materials working for magnetic refrigeration. An obvious change was also observed in MCE with increasing of Ce concentration. Finally the relation between magnetic transition and MCE was also discussed

Simulation tools for physical simulation of electronic devices

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The appearance of new devices and the size reduction of commercial devices give rise to important research works from both technological and theoretical aspects. The understanding of physical mechanisms is a key point for optimization of electronic devices. In this context simulations tools bring important contributions in many ways : (a)Understanding fundamental properties of materials and simple structures of low dimensions, (b)Manage complex geometries, and structures including basic properties of materials and interactions between them. (c)Multi-physical approaches... We briefly describe the simulations tools we have developed and give many examples of results obtained. Two dimensional time dependent simulation of ferroelectric materials (self-consistent solvation of Ginzburg-Landau together with Maxwell Gauss and Landau -Khalatnikov equations) and the application to the study of switching in ferroelectric memories. Monte Carlo simulation of Uni-traveling carriers photodetectors based on GaInAsN and GaAsNSb compounds. Electromagnetic and electrical time-domain macroscopic physical numerical modeling of semiconductor devices (1D, quasi-2D and 2D) and their related circuits for microwave, optoelectronic and thermoelectric applications. Realistic modeling of field effect transistor by the Monte Carlo method : evolution from 2D to 3D simulators. Application to estimation of extrinsic effects on III-V semiconductor nano-devices for high-speed electronics. Monte Carlo simulator of quantum cascade lasers, which describe both electron transport in the active material and photon population in the resonant cavity. It can be applied to the study of time dependent operation of these lasers.

Structural and electrical studies of $Pb_{2(1-x)}Gd_xK_{(1+x)}Nb_5O_{15}$ ceramics

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Several compounds of $Pb_{2(1-x)}Gd_xK_{(1+x)}Nb_5O_{15}$ family were synthesized by solid state reaction as ceramics. In this work, we show the existence of a morphotrophic region around x=0.35 and a structural changes evidenced by dielectric measurement and Rietveld calculations. The character of the ferroelectric-paraelectric transition is strongly influenced by the gadolinium composition rate.

NbF5 ADDITION FOR REDUCED HYDROGEN DESORPTION TEMPERATURE OF BALL-MILLED MgH2

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Magnesium is among the most promising materials for hydrogen storage applications since it forms a dihydride providing 7.6 wt.% of hydrogen. Despite its high hydrogen content, the hydride formation is very slow and occurs at very high temperature (above 300 °C). Among the ways to improve its sorption properties, i.e. faster kinetics and reduced desorption temperature, the catalyst addition remains one of the most promising. As a matter of fact, we recently reported the desorption of 4.5 wt%. and 3 wt%. of H_2 at temperatures as low as 200 °C and 150 °C for ball-milled MgH_2 catalyzed with Nb_2O_5 and NbF_5, respectively. Investigation of other catalysts reveals that oxy-fluorine compounds are also active. In this presentation, the role of the catalyst on improving the sorption properties of ball-milled MgH_2 will be discussed in relation with its chemical and physical nature.

Nb Nanolayers with Advanced Superconducting Properties and SF-Nanostructures for Superconducting Spintronics

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The novel technology for preparation of high quality superconducting Nb films with precisely constant thickness and smooth surfaces, and SF-nanostructures is developed. On the prepared Nb/CuNi layered nanostrucures we reported the first conclusive experimental observation of re-entrant behavior of superconductivity and large amplitude oscillations of the superconducting Tc, as the evidence of realization of the quasi-one dimensional Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) state in a ferromagnetic layer. The new phenomena can serve as the base for spin-vale – base elements of spintronics.

Filters for THz radiation

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The design, measurement and analysis of a range of artificial materials for use at terahertz frequencies is described. Terahertz frequency time domain spectroscopy is performed on these structures in the range 200GHz to 3.0 THz and the relative transmission of the structures is determined. The pass and stop-bands are observed with peak transmission of up to 97%. Finite difference time domain simulations and complex photonic bandstructure calculations are shown to provide good descriptions of the electromagnetic properties of the structures and are used to interpret the observed transmission spectra. Analysis of the possibilty to use developed components in the air contamination test systems was discussed.

Clays and clay minerals in High Atlas of Marrakech

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The modern society uses clays and clay minerals in increasingly large quantities; research allowed a broad variety of technological applications of clay minerals in industry. They are used in increasingly diversified fields: ceramic industry, industry of cements, metal alloy, therapeutic use, manufacture of absorbing paper... the improvement of the industrial techniques and the chemical treatments continuous to increase the use of the varieties of clays and clay minerals In Morocco, the use of clays in industry is still very restricted. In the area of the High Atlas of Marrakech more particularly, except for some exploited deposits in a craft way, the industrial exploitation remains insufficient. This region constitutes one of the areas of Morocco where the clay formations are very abundant and much diversified (Triasic, Cretaceous, Tertiary and Quaternary).The mineralogical and geochemical study, the genesis and the diagenetic transformations undergone by clays were largely approached. The results obtained show that the clay processions of this area are much diversified; all the clay mineral species are represented. The palygorskites and sepiolites), are present sometimes with contents which can currently reach 90 %. More recently, several studies are undertaken, the purpose of these studies are to evaluate the economic potential of these clay outcrops and to consider the reserves exploitable.

New method for preparation of polycrystalline langasite $La_3Ga_5SiO_{14}$: structural studies

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Langasite $La_3Ga_5SiO_{14}$ (noted LGS) is a performing piezoelectric material presenting a strong electromechanical deformation at high temperature (up to 1000-1200°C), allowing its coupling with a catalytic phase working at high temperature (up to 600°C). Classical solid state reaction at high temperature (1450°C) is generally needed to synthesize the LGS phase. In this study, we present a new synthesis way for polycrystalline langasite (LGS), involving a series of specific thermal cycles at moderate temperatures (<1200°C). Thin films were obtained via sol gel route associated with spin coating deposition process. The final langasite phase is then characterized by X-ray diffraction, scanning electron microscopy and infrared spectroscopy. Rietveld refinement gives structural parameters in full agreement with literature data. The ceramics phase was clearly identified from XRD analyses as being the phase giving rise to high performance piezoelectric responses. Successions of chemical steps are proposed to interpret the final result obtained at relatively low temperature. FTIR analyses allow attribution of IR vibrational modes. Large IR absorption bands are associated with polarized La-O bonds.

HIGH-QUALITY SUPERCONDUCTING MgB_2 FILMS FOR MICROELECTRONICS

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The novel technology for preparation of high quality superconducting MgB_2 films with a transition temperature Tc up to 39.4 K is developed, using DC-magnetron sputtering and post annealing in a specially designed Nb-reactor. The AFM surface patterns demonstrate a smooth surface of the films with an RMS roughness of ~ 6.3 nm. Prepared films are promising for high frequensy electronic applications.

Helical nanostructures and Aharonov-Bohm rings in a transverse electric field

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We show that a quasi-one-dimensional helical nanostructure in the presence of an electric field normal to the helix axis behaves as a superlattice with parameters controlled by the applied field. This behavior includes Bragg scattering of electrons on a periodic potential, which results in the energy gap opening at the edge of the superlattice Brillouin zone. The gap is proportional to the helix radius and the strength of the applied electric field. The energy spectrum of an electron confined in an infinitely-narrow ring pierced by a magnetic field flux (Aharonov-Bohm quantum ring) subjected to an in-plane electric field is exactly the same as the energy spectrum of an electron in a helix in a transverse electric field, with the magnetic flux through the ring playing the same role as the electron momentum along the helical line. For the quantum ring, the energy gap proportional to the applied electric field and the ring radius is opening between the ground and the first excited states, when the flux through the ring is equal to an odd integer number of the one-halves of the flux quantum. The electric field mixes two degenerate states with angular momenta differing by one. This effect persists in the case of a finite-width ring in a uniform magnetic field, and it can be used for creating nanoring-based qubits, which do not require weak coupling between the electric field and spin.

Pyroelectric properties of PMNT-Single Crystals

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PMNT single crystas are promising candidates for pyroelectric applications, including gas analysis and IR-imaging arrays. In this paper, the ferroelectric and pyroelectric properties of single crystals detectors thinned to 50 μm as well as detector performace will be presented.

Universal Properties of Ferroelectric Domains in Thin Ferroelectric Films

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We propose an effective way to compare the experimental properties of different multi- domain ferroelectric films by mapping them onto each other using a scaling approach. A simple interpolation formula for the evolution of a multi-domain polarization profile P(x,z) as function of temperature is derived.

Electrical properties of nano-crystalline $LiCoO_2$ cathode material .

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A new method based on combustion at low temperature is used to synthesize $LiCoO_2$ materials. The structural properties of obtained samples have been examined by X-ray diffraction associated to Rietveld refinement and by Beam Electronic Microscopy. The formation of well-crystallized hexagonal particles with average size varying from 2.5 nm to 100 nm is confirmed. Transport charge properties are also investigated in the present study. Resistivity measurements were made over the temperature range of 10-300K. The results suggest Mott-type hopping conduction at low temperature, while the

data below 200K are consistent with the Seto model. All these analysis show that the optimum synthesis condition is calcinations at 800°C for 1h in air for 1.5 mole ration of sucrose to nitrate. A relatively good cycling performance was obtained with a first discharge capacity of 157 $mAhg^{-1}$ at 0.2C .

Characterization of structure defects in nanocrystalline copper prepared by high energy mechanical milling

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Nanocrystalline copper with a mean crystallite size of 23 nm was synthesized directly by mechanical milling (MM) in a high–energy vibrator mixer-mill. X-ray patterns were analyzed to determine the mean crystallite size, the lattice strain, probability of the stacking faults and the lattice parameter. The morphological changes during mechanical milling were investigated by scanning electron microscopy (SEM). As a result, nanocrystalline powder has been synthesized with microstructure showing a mixture of highly strained crystallites. This fact can reflect a significant increase of the numbers of defects created. In addition, direct oxidation of copper during milling was investigated. Calorimetric measurements, as a function of milling time, show a broad exothermal peak occurring over quite a large temperature interval, corresponding to strain release and grain growth.

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF Cua1COPPER PROCESSED BY EQUAL CHANNEL ANGULAR EXTRUSION

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Equal channel angular extrusion (ECAE) was used to investigate the formation of submicron grain in copper deformed to ultra-high plastic strains by die angle of 90°. The result was characterized by the use of transmission election microscopy (TEM) differential, scanning calorimetry (DSC), tensile tests, microhardness measurement and Scanning electron microscopy (SEM). ECA extrusions at room temperature result in a significant reduction of grain size due to a fragmentation of the preexisting coarse grains. In TEM, many grains are separated by high-angle boundaries. For the specimen deformed N=1, A drop of the hardness level was observed by annealing at 573K, indicating that a fully recrystallized state was achieved.

Towards a scientific Mediterranean Union

(Round table)

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After having reminded the main initiatives developed between Mediterranean countries over the last decades, the issues at stakes will be described within the frame of the recent declarations and intentions of the French government. The main topics and countries to be involved in a Mediterranean initiative (referred to as "Mediterranean Union") will be addressed. The landscape of the existing scientific cooperation between France and South Mediterranean countries will be depicted, with an emphasis on basic sciences, where the scientific communities of both sides of Mediterranean Sea have to put in perspective their strong links in order to be recognized by political institutions and countries, and subsequently supported.

ONRG POLICY AND MISSION

(Round table)

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