united nations
educational, scientific
and cultural
organization

international atomic
energy agency

the
abdus salam
international centre for theoretical physics

WORKSHOP ON THIN FILMS PHYSICS AND TECHNOLOGY (8 - 24 MARCH 1999)

including

TOPICAL CONFERENCE ON MICROSTRUCTURE AND SURFACE MORPHOLOGY EVOLUTION IN THIN FILMS (24 - 26 MARCH 1999)

Co-sponsored by:
IUVSTA
International Union for Vacuum Science, Technique and Applications

BOOKLET OF ABSTRACTS FROM PARTICIPANTS TO THE POSTER SESSION

SMR.1135
March 1999

THIRD WORKSHOP ON THIN FILM PHYSICS AND TECHNOLOGY

Trieste, ITALY, 8-26 MARCH,1998

"STRUCTURAL CHARACTERIZATION OF ZINC OXIDES THIN FILMS OBTAINED BY SPRAY PYROLYSIS USING DIFFERENT SALTS IN STARTING SOLUTIONS"

Dwight R. Acosta* Arturo Maldonado, M.de la Luz Olvera, René Asomoza**
*Instituto de Física,U.N.A.M.;A.P. 20-364;01000 México D.F., MEXICO
**Dpto de Ingeniería Electrica, CINVESTAV, Inst.Politécnico Nacional,A.P. 14740 0700 México D.F.,MEXICO

Zinc oxide films were prepared by spray pyrolysis and by decomposition of zinc acetate, zinc nitrate and zinc sulfate onto a glass substrate.Analytical spectroscopy techniques showed that the film stoichiometry is very close to the ZnO phase. Selected area electron diffraction patterns and X ray diffraction spectra show an hexagonal structure of wurzite type with a crystatllite size running between 10 and 35 nanometers.Preferential growth along the (002) direction was detected. The thin films microstructure was analyzed by scanning electron microscopy (SEM), conventional and high resolution electron microscopy (TEM and HREM respectively). Related to the crystal growth process a critical temperature was found around 600 K and above this temperature, the thin films are oriented along the c-axis and grains look regular in shape and size. The influence of starting solutions on zinc oxide thin films physical properties is analyzed in this work. Optical constants n and k were detemined from optical transmittance measurements and a band gap close to 3.28 eV was derived.

TOPICAL CONFERENCE ON MICROSTRUCTURES AND SURFACE MORPHOLOGY EVOLUTION IN THIN FILMS.
Trieste, ITALY, March 24 to 26, 1999

ZnO:Zr THIN FILMS PRODUCED BY SPRAY PYROLYSIS

D.R. Acosta, J.Canetas*, A.Maldonado, M.de la Luz Olvera, R.Asomoza **, R.Castanedo and G.Torres***
* Instituto de Fisica,UNAM, A.P. 20 364, 01000 Mexico D.F., MEXICO
** CINVESTAV, Instituto Politecnico Nacional,A.P. 14740: 07000 Mexico D.F., MEXICO
*** Lab. de Investigacion en Materiales:CINVESTAV IPN,Queretaro, MEXICO

Zinc oxide films are interesting materials due to their practical and potential uses like transparent and conductive layares, gas and pressure sensors and protective coatings. The production of advanced ceramics in layer configuration and based in zirconium oxides demands specific characteristics like homogeneity of grain size, dense particles and absence of particle aggregations. In this work zinc oxide thin films doped with zirconium, were prepared from solutions with doping material at several concentrations and using spray pyrolysis technique. The films were deposited over very clean sodocalcic glasses at different substrates temperatures.The effects of concentration of doping materials and of the substrate temperatures on electrical, optical, structural and morphological properties are presented and discussed.Preferential growth in the (002) direction was observed for each thin film from X ray diffractograms. Surface details like roughness were determined from atomic force microscopy and scanning electron microscopy observations. Structural details also were derived from transmission electron microscopy studies.

Bi2201 THIN FILM FABRICATION ON ANNEALING AND ETCHING TREATED MgO(100) SUBSTRATE

Farid Ahmed[1] and Kazuo Sakai[2]

[1]*Dept. of Physics, Jahangirnagar University, Savar, Dhaka 1342, Bangladesh*

[2]*Dept. of Electrical Engineering, Osaka University, 2-1 Yamadaoka, Suita-shi, Osaka-565, Japan*

To prepare atomically flat and contamination free surface on the substrate for fabricating high quality BSCCO thin films some annealing and chemical etching treatments were carried out on the MgO(100) substrate. The surface morphology dependence of MgO(100) on various annealing temperatures and duration of times with the intermediate chemical etching has investigated by Auger electron spectroscopy (AES), atomic force microscopy (AFM) and reflection high energy electron diffraction (RHEED). From the AFM observation it is found that the different reconstruction of MgO(100) surface remarkably changes over 1000□C and the atomically flat step-terrace structure appeared on MgO(100) surface by annealing over 1200□C. It is also found that various higher order superstructures were formed on the treated MgO(100) substrates by RHEED observation.

Bi2201 thin films have been fabricated on the as-received and different treated MgO(100) substrates via co-deposition process using ion beam sputtering method. It is confirmed that the quality and the surface morphology of the Bi2201 thin films fabricated on the treated substrates are worst than those deposited on the as-received one. This result most probably appeared because of the increase of surface strain which occurred due to the segregation of impurity Ca atoms and displacement of Mg or O in treated MgO(100) substrate.

ABSTRACT

TRANSMISSION BASED SENSOR FOR RH AND LPG USING PMMA

Z.A. Ansari, R.N. Karekar*, R.C. Aiyer
*** R.C.M.F. Transducer Laboratory,**
Thin Film Laboratory,
Dept. of Physics, University of Pune,
Pune - 411 007.

Glass optical waveguide sensors for humidity and cooking gas are fabricated using Poly-methyl-metha-crylate of various molecular weight are used as a sensitive clad on the waveguide surface. The clad is deposited using the spin coating method, which gives the minimum thickness of 1μm. Influence of the clad thickness on the sensitivity is also studied. It is observed that upto certain thickness the sensitivity increases and then falls down. The sensitivity observed is about 0.5mV/RH% for humidity and about 0.8mV/ppm of cooking gas. The response time is about 1s and recovery is comparatively slow for RH than cooking gas which is about 10s. The hysteresis of about 5% is observed in the response for RH whereas it is hysteresis free for cooking gas. The result of RH sensors are compared with the reported work carried out with varoius oxides as RH sensors.

Selective nickel -cadmium black coating for solar energy collector

*S. A. Morsy ,**I. A. Zaki and ***E. A. Ayob

*Metallurgy Dept, Nuclear research center, AEA, Cairo, Egypt
**Electrochemistry &Corrosion Lab., NRC, Dokki, Cairo, Egypt
***Alexandria branch, AEA, Egypt

One of the most important parts in solar energy collectors is the coating of the collector surface .The coatings converts the incident solar radiation to heat and transfer it to the medium to be heated. Several types of coatings have been used such as selective black cobalt, chromium, nickel sulfate and zinc sulfate. However Nickel -Cadmium selective black coating for the flat plate and parabolic solar collector was found to be one of the best selective black coatings because of high stability and good efficiency.

This coating was prepared by elctrodepostion technique from the bath containing Nickel sulfate, Cadmium sulfate and Ammonium thiocyanate. This work studies the changes of different properties such as quality of the surface (by Hull cell), optical properties (i.e.solar absorptance (α) and thermal emittance (ε)), corrosion (by salt spray test), and thermal cycling as the result of the addition of different concentrations of cationic, anionic and neutral surfactant additive to the bath.

The expected results of this study are to obtain a suitable type and concentration of surfactant, which gives the best properties, high stability and good efficiency of the coating of collector surface.

SELF-ASSEMBLING ORGANIC MONOLAYERS ONTO SILICON BY WET CHEMICAL REACTION

Monica Bollani, Dario Narducci,
Istituto Nazionale per la Fisica della Materia – Department of Materials Science,
via Emanueli 15, 20126 Milano (Italy),
Laura Raimondi,
Department of Organic and Industrial Chemistry,
via Golgi 19, 20133 Milano (Italy)
and Sandro Ferrari
CMBM, Trento (Italy)

Building up monolayers of organic molecules onto semiconductor surfaces is a task of growing relevance. Actually, the possibility of modifying surface properties by chemisorption is opening new horizons in materials science. In general, Self-Assembled Monolayers (SAM's) are single layers of organic molecules covalently bonded to solid surfaces. Their advantage over LB films mainly relates to their enhanced thermal stability. Actually, LB films are known to be stable up to 400-500 K, since the film-substrate binding energies are of order 0.1-0.5 eV, while SAM's are expected to tolerate much higher temperatures since the energies involved in the covalent bond (E_b) are more than one order of magnitude higher (*e.g.* E_b(Si–O) = 5.5 eV, E_b(C–O) = 2.9 eV).

In this poster, potentials and limits of radicalic routes to molecule docking onto silicon will be shown. In particular, methods were sought to detect and to control the degree of polymerization onto the silicon surface, which is an almost unavoidable byproduct of radicalic reactions.

The thermal stability of the molecular layers as well as the occurrence of Si-C fragments in Time of Flight Secondary Ion Mass spectra provided strong evidence that organic residues are linked to Si by direct covalent bonds not implying oxygen bridges. This result is extremely encouraging to all envisaged application of this method in molecular electronics.

It will be also shown that radicalic reactions can be promoted onto silicon under mild conditions. Proper use of radicalic initiators allows some control on the degree of polymerization. It has been shown that even under highly diluted conditions and low temperatures reactions take place, resulting in full coverage of Si surfaces. Furthermore, in order to obtain semi-quantitative estimates of the degree of polymerization onto silicon, computational methods were implemented to predict the relationship between the position of vibrational bands and the length of the chain. Theoretical results, further to confirm that the organic residue is assembled, allowed to evaluate that polymerization can be controlled by operating on the reagent concentration, being modulated by standard steric and electronic effects.

Growth and Structural and Electrical Characterization of YBCO/Si Thin Films

Abdeladaim M. And Bousbahi K.

Laboratoire d'Optoelectronique, Institut d'Electronique,
USTO, BP: 1505, 31000, Oran, Algeria

Abstract:

Thin superconducting films of stoechiometry $Yba_2Cu_3O_{7-x}$ have been successfully grown by r.f. sputtering on monocristal Si substrates. The growth process was done in two stages:

1) The growth of an amorphous layer:
   In order to obtain the correct stoechiometry and to avoid retrosputtering. We have tilted systematically the growth plane of the Si (111) substrates in different directions with respect to the target axis
2) Annealing at very high temperatures and in a highly pure oxigenic atmosphere necessary for the formation of the superconducting phase.

The samples have then been characterized by Scanning Electron Microscopy and (R, T) measurements.

The result show that although the surface morphology of the films is poor due to a lattice mismatch between YbaCuO and Si, the superconducting phase transition does appear in the majority of the samples we have grown.

However, there is a need for improvement of the growth method in order to obtain better samples.

STM investigation of bismuth thin film formation on Si(111) surface.

Bulavenko S.Yu.*, Melnik P.V., Nakhodkin M.G.
*bulav@boy.rpd.univ.kiev.ua

The details of bismuth thin film formation on Si(111) substrate at room temperature are presented, and the influence of first layer structure on film growth is investigated.

Bi forms 2D islands on Si(111)7×7 surface at coverage up to 1 ML . The 2D islands have lateral sizes up to 30 A and are partially ordered with respect to the 7×7 periodicity at least up to ~0.5 ML. The growth of Bi film is changed at Bi coverage more than 1 ML. 3D islands of Bi are formed on the monolayer background. The lateral shape of the islands is nearly isotropic at Bi coverage less than 2 ML. The lateral size of Bi islands is ~100Å. The 3D Bi islands interconnect with each other, creating labyrinth-like structure at θ≈4 ML and have atomically flat plateaus. The 3D islands have almost the same height and may cross substarte atomic steps without changing thickness. The film becomes continuous at θ≈6÷8 ML.

The simple 2D model is offered for explanation of morphologic transition from isotropic islands to labyrinth-like structure. The model has two basic assumptions. The adsorption is characterized with averaged length between position of atom adsorption and location of joining the island. The atom joins the island in the place with the maximum number of adjacent atoms. The model also explains high percolation threshold.

The structure of the first layer is different if obtained by condensation of 1ML of Bi on Si(111)7×7 surface with subsequent annealing up to ~480°C. This treatment results in the creation of the so called β-phase with $\sqrt{3}\times\sqrt{3}R30°$ unit cell. It is found that the 3D island on the Si(111)-β-phase(Bi) has 2D islands on top and lateral size larger than that on the Si(111)7×7 surface. The atomic steps aren't observed and the film doesn't become continuous at θ≈6÷8 ML. The 2D islands on top of the 3D islands are mainly very anisotropic in shape. It is found that the film changes during few hours after deposition. The changing of film morphology results in disappearance of strongly anisotropic 2D islands and causes mass transport from 3D island edges to island's top.

The bismuth film formation is also investigated on the Si(111)-surface with another initial first layer structure: Si(111)-α-phase(Bi), Si(111)7×7 with incorporated-Bi atoms, H terminated Si(111) and disordered Si(111).

The influence of heating up to T≈300°C on film morphology is also studied.

Structural and optical properties of nanocrystalline thin films deposited by dc magnetron sputtering

Ramesh Chandra, Praveen Taneja and Pushan Ayyub

Department of Condensed Matter Physics & Materials Science,
Tata Institute of Fundamental Research,
Homi Bhabha Road,
Mumbai - 400 005, India

Abstract

Nanocrystalline thin films of cuprous oxide (Cu2O) as well as metallic silver were grown by simple dc magnetron sputtering in the temperature range 77K - 300K on glass, quartz and Si. Powder x-ray diffraction (XRD) spectra (theta-2theta geometry) collected from the films were used as a rapid screening tool to evaluate the particle size (using a modified Scherrer technique) and the quality of the films in terms of phase purity and crystalline orientation. The relationship between sputtering gas pressure and Cu/Cu2O phase formation, and the crystallite size were studied in detail. By varying the sputtering gas (Ar) pressure in the 2 to 200 mTorr range we successively obtained pure nanocrystalline Cu, Cu + Cu2O and single phase Cu2O films. The surface morphology of these films were characterised by atomic force microscopy (AFM). Optical absorption measurements were carried out in the UV-visible range to study the energy band gap of Cu2O films.

Thin films of nanocrystalline silver were synthesised using a similar technique. In addition to a study of the phase formation and the particle size, we also made optical absorption/reflection measurements on the nanocrystalline Ag films. The absorption edge for Cu2O films corresponds to a band gap of 2.0 eV. We also observed a shift in the band edge as a function of particle size. The evolution of the crystallite size and shape of Cu2O and Ag nanocrystals fabricated by sputtering in presence of a thermal gradient was studied as a function of the nature of the sputtering gas. Various inert gases such as He, Ne, Ar, Kr, and Xe were used in the pressure range from 2 to 600 mTorr. Depending on the nature and pressure of the gas used, the average particle size could be varied in the range of 2 to 15 nm for both Cu2O and Ag.

CRYSTALLINE CARDON NITRIDE THIN FILMS WITH HIGH NITROGEN CONTENT OBTAINED BY UV LASER CHEMICAL VAPOR DEPOSITION

A. Crunteanu*,† M. Charbonnier*, M. Romand*, R. Alexandrescu†

(*) National Institute for Lasers, plasma and Radiation Physics, Lasers Department, P.O.Box MG-36, R-76 900, Bucharest, Romania

(†) Laboratoire de Sciences et Ingénierie des Surfaces, Bâtiment 305
Université Claude Bernard - Lyon 1, 69622 Villeurbanne cedex, France

Keywords: thin films, carbon nitride, ArF laser-CVD, structural characterization

Liu and Cohen prediction (1989) of the existence of a new ultrahard material based on carbon and nitrogen and with a structure equivalent to that of β-Si_3N_4 have raised a great interest due to superior properties that this new material might have: hardness higher or same as diamond, chemical and thermal stability, toughness etc. The possible applications for this type of material as magnetic media coatings, semiconductor or protective coatings for engine components has focused the efforts of the scientific community towards the experimental production of β-C_3N_4. Many techniques such as sputtering , ion beam deposition , hot filament CVD or laser ablation have been used to synthesise carbon nitride thin films. The majority of the reported experimental research has resulted in deposits with nitrogen concentration up to 40% (far from the stoechiometric value of ~ 57%) or failed to produce crystalline materials.

We present the obtaining of carbon nitride (CN_x) thin films with high nitrogen content ($x \geq 0.75$) by ArF excimer laser (λ=193 nm) irradiation of a mixture containing acetylene and ammonia, in a flow reactor. A parallel geometry of irradiation relatively to the substrate was used. X-ray photolectron spectroscopy and FT-IR techniques evidenced that nitrogen is chemically bonded to carbon in sp^3 or sp^2 configurations.

The nature of the substrates (silicon, pre-deposited TiN, glass, polymers, metals) as well as the substrates pre-treatment, strongly influenced the morphology of the deposited films, as revealed by scanning electron microscopy (SEM). X-ray diffraction shows that the films deposited on silicon and pre-deposited TiN substrates, are crystalline, with diffraction lines that match those of the theoretically predicted β-C_3N_4.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE EPITAXIAL LAYERS GROWN BY THE CHEMICAL TRANSPORT REACTION IN THE CLOSED VOLUME IN $Cd-H-Te$, $Cd-Te$, $Zn-Te$ - SYSTEMS WITH NH_4Cl, NH_4Br, NH_4J AS TRANSFERS

B.Datsko, G.Ilchuk, N.Ukrainets

IAPMM NAS Ukraine, TU Lviv

The conditions of the epitaxial layers growth by the chemical transport reactions in the closed volume with NH_4Cl, NH_4Br, NH_4J as carriers are investigated.

For this purpose by a method of chemical transport reactions the structure of a gas phase in the closed systems consisting accordingly of the solid solutions $Cd_xHg_{1-x}Te$, $CdTe$, $ZnTe$ and products of interaction with them have been calculated. For the description of heterogeneous systems we used system of independent chemical reactions, law of conservation of matter and Dalton law [1]. The study of a equilibrum structure of a gas phase permits to determine concentration of transfer for realization of experiments on a chemical transport and to reveal gaseous substances, playing main role at carry of material of source in given system.

In result the temperature dependences of partial pressures were received which have shown, that there is a rather wide area of meanings of temperatures and pressure, within the limits of which is possible to get the monocrystal by a method of chemical transport reactions at use as carrier NH_4Cl, NH_4Br, NH_4J.

The account of speed of mass transfer is based on physical model of process and general positions of molecular kinetic theory [2]. On the base of the Curtiss-Hirschfelder equations and system of independent chemical reactions received from the thermodynamic analysis, it is possible for stationary processes calculate complete flows for closed heterogeneous systems. The equations describe process diffusion in many component gas compound without thermodiffusion. As a whole the problem represents a boundary problem for ordinary differential equations with integrated conditions, which describe the laws of preservation.

The theoretical dependence of speed mass transfer of solid solutions from concentration of a carrier, for different temperatures of a deposition zone, temperature field and sizes of an ampoule is received.

The growth was carried out at 750-1400 K with carrier pressure (NH_4Br, NH_4Cl, NH_4J) $10^3 - 10^5$ Pa and by a linear temperature field and difference of temperatures 10, 30, 50, 70 K between zones of a source and deposition. At considered areas of temperatures and concentration of a carrier are grown a single crystals with the linear sizes $5 - 7mm$. Density of dislocation in the obtained epitaxial layers and single grystals are aproximatelly $10^2 cm^{-2}$, i.e. two order lower than in ones grown from melt. Is shown that the theoretical results are in quite good agreement with the experiment. It additionally confirms diffusion mechanism of mass transferring. But values of velocities of mass transferring (and growth of crystal and film as a result) is not hiht.

References

[1] Achromenko Yu. Ilchuk G. Neorg. Mater AN SSSR, 1975, v.18, p.1117-1122 (in Russian)

[2] Sandulova A., Achromenko Yu. J. Phys.Chem AN SSSR, 1975, v.49, p.1710-1712 (in Russian)

COMPOSITION OF GASEOUS PHASE AND MASS TRANSFER IN $ZnTeNH_4Br$, $ZnTENH_4J$, $ZnTeNH_4Cl$ - SYSTEMS ON THE LIMITS OF RANGE HOMOGENEITY

B.Datsko, G.Ilchuk, N.Ukrainets

IAPMM NAS Ukraine, TU Lviv

In work results of researches of mass transfer of $ZnTe$ in a closed $ZnTeNH_4Br$, $ZnTeNH_4J$, $ZnTeNH_4Cl$ systems are presented. As a base system we shall accept $ZnTeNH_4Br$. It is known that in NH_4Br the transport element is HBr. NH_4Br was placed in quartz ampoule together with $ZnTe$ directly before vacuum processes. It excluded probability of experimental errors.

The mathematical model of carry in given and similar ($ZnTeNH_4J$, $ZnTeNH_4Cl$) - systems is based on technological conditions of experiment and general positions molecular kinetic theory [1]. At construction of model we allow, that the mass-transfer is a quasiequilibrium and diffusion process. Pursuant to experiment (according to chosen by temperature conditions) the heterogeneous reaction proceeds only on a surface of a source and crystal. Whereas the homogeneous reactions proceed in all volume ampoule. The admission about existence in a system only a diffusion mass-transfer is stipulated by that conditions were used, at which the total pressure in a system did not exceed $1.01 \cdot 10^5 Pa$ even at reasonably high temperatures of research and conditions convection mass transfer were thus excluded. Therefore was at first calculated a equilibrum structure of a gas phase in a researched system. It has allowed to determine conditions at which it is impossible allocation from a gas phase condensed Te, as well as to exclude from consideration such modes, at which condition of stechiometry on Zn and Te in gas phase is not executed. The first condition can be infringed at large and second at small concentration of carrier. Thermodynamic analysis of a equilibrum structure of a gas phase in a closed system has shown, that for numerical modeling of mass-transfer can to be limited to the keeping only following gas substances: $HBr, H_2, Te_2, N_2, ZnBr_2, NH_3$.

The conditions of the epitaxial layers growth are investigate. In result the temperature dependences of partial pressures were received which have shown, that there is a rather wide area of meanings of temperatures and pressure, within the limits of which is possible to get the monocrystal by a method of chemical transport reactions at use as carrier NH_4Cl, NH_4Br, NH_4J. The theoretical dependence of speed mass transfer of solid solutions from concentration of a carrier, for different temperatures of a deposition zone, temperature field and sizes of an ampoule is received.

The growth was carried out at 750-1400 K with carrier pressure (NH_4Br, NH_4Cl, NH_4J) $10^3 - 10^5$ Pa and by a linear temperature field and difference of temperatures 10, 30, 50, 70 K between zones of a source and deposition. At considered areas of temperatures and concentration of a carrier are grown a single crystals with the linear sizes $5 - 7mm$. Density of dislocation in the obtained epitaxial layers and single grystals are aproximatelly $10^2 cm^{-2}$, i.e. two order lower than in ones grown from melt. Is shown that the theoretical results are in quite good agreement with the experiment. It additionally confirms diffusion mechanism of mass transferring.

References

[1] Achromenko Yu. Ilchuk G. Neorg. Mater AN SSSR, 1975, v.18, p.1117-1122 (in Russian)

Chalcogenide-based Phase Change Thin Films For Optical Storage

D.Dimitrov
Central Laboratory of Photoprocesses
Bulgarian Academy of Sciences, Sofia, BULGARIA

ABSTRACT

Chalcogenide - based phase-change media are best suited materials for the optical storage with direct overwrite mode. CD-RW and PD discs , both utilizing phase-change storage films were introduced in the market. Moreover rewritable phase-change DVD-RAM is considered as potential high memory device for multimedia computers. The engineering and development aspects of the phase-change storage however still outrun the underlying scientific understanding of the various thermally induced processes in these chalcogenide based materials. We present the results of investigation of crystallization kinetics and short-wavelength optical properties of Sb-Se alloy films. The crystallization process is studied by two techniques: real time monitoring of changes in optical transmission and differential scanning calorimetry using constant rate and isothermal heatings. We show the influence of substrate/film interface on crystallization activation energy and transformation mode. Optical properties of Sb-Se alloy films with different compositions are measured at wavelengths from 400 to 900 nm. The experimental results are used to compute optimal film thickness and a maximum reflectance/transmittance changes.

VARIABLE ANGLE SPECTROSCOPIC ELLIPSOMETRY AND ATOMIC FORCE MICROSCOPY FOR ISLAND METAL FILMS ON SEMICONDUCTOR SUBSTRATE (Au/GaAs)

N.Dmitruk[(1)], T.Lepeshkina[(1)], M.Pavlovska[(2)], O.Rengevych[(1)], V.Romaniuk[(1)] and T.Wagner[(3)]

[(1)] Institute of Semiconductor Physics of NASU, Kyiv, Ukraine

[(2)] Taras Shevchenko National University, Kyiv, Ukraine

[(3)] L.O.T.-Oriel GmbH, Darmstadt, Germany

In this paper the local electrochemical growth of noble metal films (Au) on semiconductor substrate (GaAs) and the morphologies of both gold covering and substrate are investigated. Atomic force microscopy (AFM) and variable angle spectroscopic ellipsometry (VASE) were used for this aim.

Gold discontinuous (island) films have been grown from aqueous solution of $AuCl_3$ with the Au^{3+} ions concentration of about 10^{-5} gram-ion/l at pH=1÷2. An illumination with the hν>1.5 eV quanta promoted this process because after absorption from solution the Au^{3+} ions have been neutralized by the capture of electrons, i.e. continuous process of generation of broken atomic bonds and dissolution of substrate around the gold islands takes place. After removal of gold by dissolution in water solution of ammonium persulphate we observed a microrelief (wavy) surface of GaAs. This morphology changes were revealed by electron microscopy and AFM, multi-angle-of-incidence (MAI) ellipsometry confirms the smooth character of such microrelief GaAs surface.

Optical measurements were performed by Woolam spectroscopic ellipsometer VASE equipped with vertical sample stage and autoretarder in the spectral range 270 - 1700 nm for three different angles of light incidence. To analyze the data we combined all angle spectra and fitted to all data simultaneously. The optical constants $n(\lambda)$ and $k(\lambda)$ of island absorpting film on GaAs substrate depend on film thickness, i.e. on gold clusters size. The dimensional effects are analyzed with taking into account the peculiarities of both surface plasmon excitation and morphology of coating and substrate. The results obtained were interpreted by the modified symmetrical Bruggeman's effective medium theory in $3D$ or $2D$ dimension model. According to results of calculations an adequate description of optical properties of island films as a function of the filling factor f is possible in a wide range of f.

Wetting thin layers deposited on solid substrates by island films

N.T.Gladkikh, S.V. Dukarov

Kharkov State University
Scientific Center of Physical Technologies

Research in wetting with island films permits one to study the properties of surface phenomena in high dispersion systems and to obtain the parameters of a solid body surface that are important for applications. We have studied the wetting of films with variable thickness deposited onto solid substrates for different kinds of interaction between liquid drops, film and substrate (Sn/C/KCl, Sn/Al/NaCl, Pb/Ni/NaCl, Pb/Ni/Si, Pb/Ni/GaAs, Bi/Fe/KCl). In this case the contact angle θ depends on the intermediate layer thickness t and varies from the value corresponding to the wetting of a pure substrate (for $t \to 0$) to one for the wetting of the film material in bulk (for $t > t_c$). Limiting thickness t_c is determined by the type of interaction between the components and amounts to 50 - 100 nm for the components dissolved in one another and(or) for those forming chemical compounds. If these factors do not work, the value t_c does not exceed 10 nm. The dependences observed are attributed to the heterogeneous wetting surface.

Our results together with the available data permit one to separate the basic forms of dependences $\theta(t)$ for wetting the film on a solid substrate with the melt.

a) Non-interacting systems (Sn/C/KCl). The quantity t_c is order of some nanometers.

b) Systems in which the intermediate film is soluble in a liquid metal (Pb/Ni/NaCl). Another characteristic thickness t_s is observed in the dependence $\theta(t)$ up to which the intermediate film is completely dissolved in the melt.

c) Systems with film - substrate chemical compounds (Pb/Ni/GaAs).

One can split such systems into two subsystems of a simpler type: "melt - layer of the compound formed - solid substrate" and "melt - intermediate film - compound layer". In accordance with this argument the dependence $\theta(t)$ has two critical thickness values.

MAGNETIC PROPERTIES OF Sr-M THIN FILMS GROWN BY PULSED LASER ABLATION DEPOSITION

J.C. Faloh-Gandarilla[a], S. Díaz-Castañón[a], F. Leccabue[b] and B.E. Watts[b].
[a]Lab. Magnetismo, Facultad de Física-IMRE, Unversidad de La Habana, La Habana CP 10400, Cuba.
[b] Istituto MASPEC/CNR, Via Chiavari 18/A, 43100, Parma, Italia.

At present the evaluation of different routes to prepare polycrystalline thin films based on hexagonal ferrites is of considerable interest due to the excellent properties of these materials as high density magnetic recording media. In the present work polycrystalline Sr-M ($SrFe_{12}O_{19}$) thin films were deposited on Si substrates by PLAD using a XeCl excimer laser system (λ= 308 nm) at different temperatures (600-850°C) and oxygen pressures regimes (0.1-2.0 mbar). Samples were characterized by X-ray diffraction, scanning electron microscopy and vibrating sample magnetometry. No significant differences in chemical composition were observed between the target and films. In samples obtained in the temperature range 600-750°C a good homogeneity in morphology and grain size was observed. These samples are mainly formed by nanocrystalline particles showing a coercivity (5900-6500 Oe) and saturation magnetization (260 emu/cm^3) in correspondence with the highest values reported in thin films, powders and sintered samples of this compound.

POLYMERIC THIN FILMS BASED ON DONOR-ACCEPTOR COMPLEX FOR PHOTO-ENERGY CONVERSION AND STORAGE

M. Hadjieva, Tz. Filipova[2], G.Advincula[1]
Bulgarian Academy of Sciences, [2]University of Chemical Technology,
[1]Stanford University

Photo-Induced electron transfer in thin films Donor-Acceptor/D-A/ organic systems is studied for applications in solar energy conversion and storage. Some organic compounds like new synthesized viologens have attractive features in Donor-Acceptor complex due to the photolytic excitation with visible light, The energy transfer process is realized during reversible electron transition and is influenced by strong electron affinity of the new synthesized viologen. Fluorescent and phosforescent investigations allow evaluation of the energy absobed and stored from D-A layered structure.

The thin film architecture and macromolecular assambly of D-A thin film structures are studied as follows:

- alternative viologen/acceptor/ and amine polymer /donor/ layers,
- spatially separated donor and acceptor layers - use of a passive polyelectrolyte,
- different thicknesses of donor and acceptor layers.

The correlation a layer structure and order with quantum efficiency of the electron transfer process in D-A polymeric thin film is studied and described/domain formation, anisotropy, crystallization, etc correlated with the observed photophysical properties/.

The obtained data help alttle better undertanding of the structural and behavioral properties of the multilayered thin film D-A system for improving the structural stability and energy transfer parameters for better applications.

"Growth and Structural Properties of iron oxide layers"

B. Handke [1),2)], T. Ślęzak [1)], M. Kubik [1)], J. Korecki [1)]

[1)] Academy of Mining and Metallurgy, Faculty of Physics and Nuclear Techniques, Department of Solid State Physics, Al. Mickiewicza 30, 30-059 Kraków, Poland

[2)] Polish Academy of Sciences, Institute of Catalysis and Surface Chemistry, ul. Niezapominajek 1, 30-239 Kraków, Poland

The properties of clean metal-oxide surfaces and the adsorption of gases thereon is of great interest in catalysis research, since is not much known about atomic scale surface chemistry on metal oxide catalysis yet. Single crystal films allow us to study ordered oxide surfaces without using single crystal samples which sometimes are not available or may cause electrostatic charging problems. Epitaxial iron oxide layers where grown on Au (100) buffer layer or directly on a cleaved MgO (100) substrate by condensation from the molecular beam of Fe^{57} in oxygen atmosphere. By varying the O_2 flow, the iron deposition rate and the substrate temperature, different Fe-O phases can be grown. Surface morphology of the grown films was observed by LEED and STM. By Conversion Electron Mössbauer Spectroscopy (CEMS) is easy to identify the different oxide phases and stoichiometry. Fe_3O_4 could be stabilized in a broad partial O_2 pressure range, at near ideal 2:1 stoichiometry of iron ions octahedral and tetrahedral sites. This result is due to chemical reaction of Fe and O_2 in gas phase. Growth mode is perfect layer-by-layer for MgO(100) substrate, resulting in Fe_3O_4(001) surface structure. For Au(100) buffer layers, Fe_3O_4 islands growth type with (111) orientation was observed.

Recrystallization of strained $Si/Si_{1-x}Ge_x/Si$ structures from amorphous state

M Q Huda
Dept. of EEE, Bangladesh University of Engineering & Technology

$Si/Si_{1-x}Ge_x/Si$ multiple quantum well structures have been recrystallized from amorphous state by the process of Solid Phase Epitaxy (SPE). UHVCVD grown quantum well samples with a germanium fraction of up to 13% were investigated. The quantum well layers were completely amorphized by silicon implantation at liquid nitrogen temperature. Samples were then recrystallized by SPE at temperatures in the range 550°-650°C. No sign of misfit dislocations or any other extended defects were observable within the TEM resolution in the regrown quantum well layers. Absence of segregation or diffusion of germanium atoms from the growth interface resulted in recrystallization of the quantum wells with sharp interfaces. The density of misfit dislocations in the regrown structures estimated by X-ray analysis were small, and much lower than that in the original as-grown sample. Lower temperature SPE regrowth resulted in a slower growth rate, but with better structural quality. Prolonged annealing of samples longer than the time required for full recrystallization resulted in formation of point defects which dominated the luminescence spectra in the range of 0.9-1.0 eV. Quantum well related luminescence was obtained after an additional rapid thermal annealing of the SPE regrown sample. The process introduced slight strain relaxation, but the overall contribution from defect related radiative and non-radiative recombination routes was sufficiently small to allow the observation of luminescence attributable to the quantum wells.

ABSTRACT

On the Structural Evolution of a-GexC1-x Films Uppon Annealing

Luiz Gustavo Jacobsohn(*) and Fernando Lázaro Freire Jr.
Departamento de Física - PUC-Rio
Cx. P. 38071
22452-970 Rio de Janeiro, RJ - Brazil
(*)jaco@fis.puc-rio.br

There is a strong interest in obtaining germanium nanocrystals as for application as quantum dots. Among the several methods already employed to obtain Ge nanocrystals, the use of amorphous carbon to confine Ge is a promissor one due to the low solubility of Ge in C. It is the aim of this work to investigate the structural modifications of amorphous carbon-germanium (a-GexC1-x) films under thermal treatment as a function of annealing temperature and annealing time. Special attention on the formation of Ge nanocrystals was taken. Films with different composition were deposited by dc-magnetron sputtering of a graphite target induced by a 0.36 Pa argon plasma, being the amount of Ge to be incorporated into the films controlled by the number of ultra-pure Ge strips put over the target. The film composition was determined by ion beam techniques. Both isochronal and isothermal annealings were carried out in vacuum, in the 300-600 oC tamperature range, with the furnace temperature flutuation not bigger than 1 % of its nominal temperature as measured by a chromel-alumel K type termopar. The structural evolution was followed by scanning electron microscopy (SEM) and grazing incidence x-ray diffraction analysis (GXRD), providing evidence of Ge crystallization. Within the annealing time and temperature ranges of this work, the appearence of Ge nanocrystals is restricted to Ge-rich films only.

GROWTH AND CHARCTERISATION OF BINARY AND TERNARY PITAXIAL LAYERS FROM LIQUID PHASE EPITAY

K.JEGANATHAN AND J.KUMAR
Crystal Growth Centre
Anna University, Chennai - 600 025, INDIA
Fax: 91-44-2352774; Phone: 91-44-2352774
E-mail: kjeganathan@hotmail.com

Interfacial Energy Epitaxial (IEE) layers of AlGaAs/GaAs heterostructure have been realised from Liquid Phase Epitaxy (LPE) even under the condition of undersaturation of the melt. he IEE growth was realised in a semi-transparent gold coated furnace under hydrogen ambient from the undersaturated Al/Ga/GaAs solution. IEE is complementary to conventional liquid phase epitaxy: after saturation, the temperature of the melt is raised to a constant growth temperature (Tg) which will be just above the saturation temperature (Ts). Thus the prepared undersaturated solution was made in contact with the substrate at constant temperature. After IEE epitaxy, growth has been terminated and the system has been allowed to cool to room temperature by forced cooling. The different isothermal contact time of substrate and the undersaturated melt does not change the growth behaviour. A small change in interfacial energy between substrate and melt provides the driving force for the heteroepitaxial layers. The thermal profiles of IEE-LPE growth and the characterisation results will be discussed in detail. Epitaxial growth of GaAs from Ga, Ga-Bi mixed solution and AlGaAs from LPE will also be presented in detail.

Microstructure investigation of thin films and rapidly solidified quasicrystalline alloys

A. Jianu, R. Nicula, R. Manaila, G. Holzhuter**, E. Burkel**
*National Institute for Materials Physics, Bucharest, Romania
** LP Physik für Neue Materialien, Univ. Rostock, Germany

In 1984, the discovery of a phase showing icosahedral symmetry in a rapidly quenched sample of Al-Mn greatly excited the crystallographic and physics communities [1]. Though icosahedral symmetry is inconsistent with translational periodicity, this new material showed crystal-like behavior, thus forcing a fundamental revision of understanding atomic arrangements in condensed matter. These new phases - called *quasicrystals* (QC's) - have since been found in many transition metal (TM) alloys, most notably in Al- or Ti-based systems.

Quasicrystals can be related to complex crystalline phases with large unit cells (crystalline approximants - CA), which also exhibit a variety of interesting properties. The observed QC/CA structural features, material properties and stability firmly place this new class of intermetallic solids within the traditional framework of crystalline intermetallic compounds.

In contrast, nanophased QC's have a relatively short history. The first studies date from 1992, when ultrafast quenching techniques such as melt-spinning and gas atomization were employed by A. Inoue and coworkers (Institute of Materials Research, Sendai, Japan) to obtain nano-QC phases in several Al-rich alloys [2].

The preparation and study of stable metastable quasicrystals (QCs) as thin films is a subject of growing interest, although few studies have been published so far [3,4]. Quasicrystalline thin films can serve as a tool for studying the growth and stability of quasicrystals, as well as dimensionality effects of their physical properties.

AlMnCe alloys with nanoquasicrystalline structure was prepared by melt spinnig technique. Thin films from the same systems are prepared by R.F. sputtering and laser ablation. The research was focused to the investigation of the (micro) structure using X-ray diffraction and electron microscopy.

References

1. D.Schechtman, I. Blech, D. Gratias, S..W. Cahn, Phys. Rev. Lett. 53, 1951 (1984)
2. A. Inoue, M. Watanabe, H.M. Kimura, T. Aiba , T. Masumoto, Mater. Trans. JIM 33, 723 (1992)
3. R. Manaila, Popescu, G. Korony, A. Jianu, A. Deveny, B. Barna, A. Csanady, Thin Solid Films, 251, 14 (1994)
4. F, Giroud, T. Grenet, T.M. Schaub, C. Berger, P.B. Barna, Z. Radi, in *Quasicrystals*, Proceedings 6th Int. Conf. on Quasicrystals **ICQ6** (Tokyo, Japan), eds. S. Takeuchi & T. Fujiwara, World Scientific, 301 (1997)

Effects of temperature on the resistivity of vacuum deposited Cu-MgF_2 cermet thin films: an investigation of conduction mechanism

G Katumba and L Olumekor

Physics Department, University of Zimbabwe, P O Box MP 167, Mt Pleasant, Harare, ZIMBABWE

E-mail: katumba@compcentre.uz.ac.zw

Abstract

Cermet thin films of Cu-MgF_2 were deposited onto glass substrates using conventional resistive heating co-evaporation technique. The films of compositions 40, 60 and 80 vol. % Cu and thicknesses 60, 145 and 285 nm were deposited at elevated substrate temperatures between 300 K and 393 K in a vacuum of 1.33 x 10^{-3} Pa. Room temperature d.c. resistivity measurements were performed at atmospheric pressure from which activation energies and TCRs for the cermet films were determined. It was observed that the resistivity,(ρ) data fitted into the $ln\ \rho \propto 1/T$ relationship. The activation energies were found to decrease with increase in film thickness and increase in metallic content of the cermet films whilst the TCRs were all negative. From the trends in both activation energies and TCRs it was concluded that the predominant conduction mechanism was tunnelling of thermally activated charge carriers.

Keywords: resistivity, activation, tunnelling.

MODELING OF THIN FILM TRANSISTORS ON FLEXIBLE SUBSTRATES

Microelectronics Research Center

Hamide Kavak*,Carl Gruber, Howard Shanks**
Iowa State University Microelectronics Research Center
Ames, Iowa 50011

The use of polyimide as a flexible substrate material for amorphous silicon ultra thin electronics is a rapidly developing area of technology. A class of L= 2 to 20 micrometer minimum feature size inverted gate thin film transistor circuitry has been demonstrated, including individual devices and switches with W/L from 1 to 1,200, inverters, drivers and receivers, ring oscillators logic circuits and SRAM cells on 6 μm and 75 μm polyimide substrates. The technology developed, is compatible with roll-to-roll processing and mass production. Uses include displays, imaging, smart cards and a variety of unique circuit applications including true three dimensional circuits.

In this work, we report on the use of HSPICE ( ) to model the current voltage characteristics of individual transistors on polyimide with different W/L ratios. All results are for transistors on 5 μm thick polyimide substrates. In addition the effects of light on the characteristics of the device are explored.

ABSTRACT

THE HIGH POWER ULTRASONICS IN THIN FILM TECHNOLOGY

Victor KOLOMYTSEV
Oleksandr KOZLOV

Institute of Metal Physics
Vernadsky Street 36
252141 Kiev 142
Ukraine

Three ways of the high power ultrasonic application in the thin film technology will be discussed. The first one is the ultrasonic atomization of molten metals and alloys and their deposition on various substrates. The advantages of this method are expected to be the possibility to adjust kinetic energy and diameter of the molten metal drops during manufacturing of thin film. The second way of the ultrasonic application is the ultrasonic flattening technique for the metal films and ribbons. In this technique we can decrease the thickness of the films/ribbons and improve their surface qualtiy and microstructure. The third way of the ultrasonic application is the cavitation treatment of the molten alloy prior to the thin ribbon production by rapid solidification technique. In this way we can decrease the "porosity" of the ribbons. This way may be used also for manufacturing of the composite material thin films and ribbons. High power ultrasonic can be used in the mechanical alloying technology for thin films. This application of ultrasonics also will be discussed.

Decreases in Lattice Parameter and Vacancy Formation Energy in Small Metal Particles.

N.T. Gladkikh, O.P. Kryshtal

Kharkov State University
Scientific Center of Physics and Technology

A large number of papers report the lattice dilatation in small metal particles with the decrease of their size. But presently one has no generally accepted opinion about the dilatation value and as well as it's sign. Also one has no universal conception for the explanation of the various structural size effects in small particles. Actually the situation is confusing because the notion of a surface stress used conventionally to treat the observed decrease of the lattice parameter in small particles has been shown lately to fail altogether.

In our work we present the experimental data of the electron diffraction investigation of the lattice parameter dilatation in small particles of island films of several fcc metal. It was shown that the data obtained under suppression of the influence of gaseous impurities indicate the decrease of the lattice parameter of investigated metals with their size decreasing.

In this work we are developing the vacancy mechanism of size effects introduced earlier by us. It's main idea is the increase of the equilibrium concentration of vacancies in small particles with their size decreasing as compared with that in the bulk.

The treatment of the obtained experimental data taking into account the vacancy mechanism shows the predominant role of the surface and near-surface vacancies. The formation energy of these vacancies also decreases with their size decreasing and attains the values 0.25-0.3eV.

We also present a simple expression for evaluating the vacancy volume. The values for single vacancy volume for 25 metals are obtained.

The account of the increased concentration of vacancies allows one to explain from one viewpoint several physico-chemical properties of small particles, for example, the huge rate of sintering, catalytical activity, the "liquid-like" coalescence discovered long ago etc.

Controlled Manipulation of Single Adsorbates on Metal Surfaces

Saw W. Hla, Angelika Kühnle, Ludwig Bartels, Gerhard Meyer, and Karl-Heinz Rieder

Fachbereich Physik of Free University of Berlin

Arnimallee 14

14195 Berlin

We have performed the controlled manipulation of 1,4-Diiodobenzene on Copper (211) and (111) surfaces with the scanning tunneling microscope (STM) tip at low temperatures (13 K). Copper (111) is an atomically flat surface, whereas the Copper (211) surface consists of atomic troughs with a 6.25 Å distance. We determined the modes of manipulation on the surfaces and at the step edges. On clean Copper (111) surface the adsorbates can be moved in a pulling mode. At the step edges on Copper (111) the movement is found to be in sliding mode. This is also observed along the troughs on Copper (211) surface.

Comparative study of the microstructures between SnO_2 thin films grown by physical evaporation and pulsed laser deposition

A. Lamagna , M. Vignolo[3], L. Quinteros , C. F. Arrieta[1],
J. Gimenez[1] , L. Dori[2] , S. Duhalde[3]
Depto. de Física, Comisión Nacional de Energía Atómica,
Av. del Libertador 8250,1429 Buenos Aires, Argentina

The recent trend of gas sensor technology asks for thin films sensing layers with a nanostructure morphology.

In this work we compare the microstructure of SnO_2 thin films (2000 A) on (100) Si wafers buffered with a Si_3Ni_4 layer grown by two different kind of technique.

We use physical evaporation of metallic tin on micro mechanised silicon substrate held at 400 ºC. After deposition the Sn films were annealed at 600 °C with flowing oxygen during 30 hours. This technique, the Rheotaxial Growth and Thermal Oxidation (RTGO), produces polycrystalline grains connected by necks with high surface areas. For the films deposited by pulsed laser deposition, we used metallic tin or SnO_2 targets. The substrate temperature were fixed at 700 ºC and the depositions were performed in oxygen atmosphere. This technique produces SnO_2 films without post-annealing treatment.

The microstructural properties of all the films were analysed using SEM and TEM microscopy of the interfaces, and x-ray diffraction.

(1) División Semiconductores, CITEFA, Zufriategui 4380, 1603 Villa Martelli, Argentina
(2) CNR-Istituto LAMEL, via Gobetti, 101 I-40129 Bologna, Italy
(3) Departamento do Física, Facultad de Ingeniería, Universidad de Buenos Aires,
Paseo Colón 850, 1063 Buenos Aires, Argentina

Abstract:

The study of molecules orientation in the sublimated films of *meso*-tetraphenylporphyrin and its metallocomplexes by IR spectroscopy.

G. Martirosyan, T. Kurtikyan,

Molecular Structure Research Center of National Academy of Science,
375014, Yerevan, Republic of Armenia.

In this work the possibility of orientation of MTPP (M=H_2, Co, Ni, Cu, Zn, Sn) molecules in films, prepared by evaporation on the substrates with various temperatures, have been examined by IR spectroscopy. The orientation measurements of MTPP films shows that the intensities of IR bands in range 800 and 720 cm^{-1} exhibits the remarkable dependence from substrate tilting angle. The use of the polarized IR excitation indicates the noticeable dependence of intensities these bands from angle of polarization. The same study of the films SnTPP, in which the metal atom is displaced out-of molecule plane on noticeable distance (~ 1A) and free-base H_2TPP also reveals the orientation and polarization dependence of the intensities of IR bands at 802 and 718 cm^{-1} (SnTPP) and 798 and 718 cm^{-1} (H_2TPP). Since these bands correspond to out-of-plane deformational vibrations of porphyrin molecules, therefore there is the preferential orientation of the molecules parallel to the substrate surface.

That orientation of the molecules was observed in films prepared by evaporation on substrates at room temperature. Analogous study of the films evaporated onto low-temperature (77 K) and heated (373 K) substrates indicated very slightly orientation in former and its absence in the latter. The orientation and polarization measurements of the films with various thickness exhibits that the slightly orientation in films evaporated on the low temperature substrate caused by near situated to it surface molecules. Lack of orientation in the films evaporated on the heated substrate may be attributing to growth the crystallites and formation disordered structure. Finally, this study shows clearly, that in the sublimated films of large and relatively rigid molecules of *meso*-tetraphenylporphyrin and its metallocomplexes may to take place, depending from substrate temperature, the preferential orientation of the molecules.

MICROSTRUCTURAL CHARACTERIZATION OF CUINSE2 THIN FILMS DEPOSITED BY PULSED ELECTRON BEAM ABLATION

S. Malkov[a], A.M. Andriesh[a], H.W. Schock[b]

[a]Institute of Applied Physics, Academy of Sciences of Moldova, Academiei str 1 Kishinev Moldova
[b]Institut fur Physikalische Elektronik, University of Stuttgart, Pfaffenwaldring 47 D-70569 Germany

The main purpose of this report resides in studying microstructure of $CuInSe_2$ thin films deposited by the pulsed electron beam ablation in dependence on substrate temperatures, beam parameters and post deposition selenization step.

This method is assumed to be similar to pulsed UV laser ablation. At the same time, physically it can be related to plasma induced electron processing like sputtering. It makes it possible to realize high kinetic energy of flying particles, to change their kinetic energy in the wide range in dependence on beam parameters and to provide different micro thermodynamic growth conditions on the surface.

The preparation of thin films was initiated by the pulsed high current and magnetically self pinched electron beam at the following beam parameters and growth conditions: power < 500 MW/cm^2, pulse duration - 100 ns, beam diameter - 1.5 cm, high voltage - 10 - 18.5 kV, argon pressure - 1-3 Pa, accumulation capacitance - 15 nF, distance between target and substrate - 4.5 cm, substrate temperature - 250 - 500°C. The stoichiometric and In-rich targets were fabricated by cutting the ingots prepared by fusing components in quartz ampoule. The selenization procedure was implemented at a temperature of 500C during 15 minutes.

The composition of $CuInSe_2$ thin films prepared was found to be temperature dependent, and the Cu/In ratios were in the range of 0.8 - 1.2. The rising of substrate temperature was established to lead to the increase of the Cu/In ratio and forming the Cu-rich films deposited from stoichiometric targets at substrate temperatures higher than 400C. However, application of In-rich targets made it possible to prepare the In-rich and stoichiometric films at temperatures as high as 500C.

The X-Ray Diffraction patterns of the films deposited at substrate temperatures in the range of 250 - 500C were established to have the peaks with odd hkl indexes typical for sphalerite structure and <112> preferential orientation. However, for the films deposited at temperatures higher than 350C or exposed to selenization procedure the peaks with odd hkl indexes characterizing chalcopyrite structure appear. The Scanning Electron Microscopy measurements indicated on columnar grain microstructure with the grain sizes as large as 0.5 mkm. It was established that the selenization step of films prepared at low substrate temperatures significantly improved the microstructure of these films.

The <112> preferential orientation and fiber microstructure of films prepared by this method are assumed to support a lateral growth mechanism and are a prerequisite for the fabrication of high efficiency solar cells on the base of these films.

DEPOSITION OF CUINSE2 THIN FILMS BY PULSED ELECTRON BEAM ABLATION

S. Malkov[a], A.M. Andriesh[a], H.W. Schock[b]

[a]Institute of Applied Physics, Academy of Sciences of Moldova, Academiei str 1 Kishinev Moldova
[b]Institut fur Physikalische Elektronik, University of Stuttgart, Pfaffenwaldring 47 D-70569 Germany

The main purpose of this report resides in application of a novel technology method - pulsed electron beam ablation for depositing $CuInSe_2$ thin films - one of the most promising materials for thin film photovoltaics.

This method is assumed to be similar to pulsed UV laser ablation. At the same time, physically it can be related to plasma induced electron processing like sputtering. It makes it possible to realize high kinetic energy of flying particles, to change their kinetic energy in the wide range in dependence on beam parameters and to provide different micro thermodynamic growth conditions on the surface.
In this paper a series of CuInSe2 thin films have been prepared and the morphological, compositional, structural, optical and electrical characterization of films prepared has been carried out.

The preparation of thin films was initiated by the pulsed high current and magnetically self pinched electron beam at the following beam parameters and growth conditions: power < 500 MW/cm^2, pulse duration - 100 ns, beam diameter - 1.5 cm, high voltage - 16 kV, argon pressure - 1-3 Pa, accumulation capacitance - 15 nF, distance between target and substrate - 4.5 cm, substrate temperature - 400 C. The stoichiometric targets were fabricated by cutting the ingots prepared by fusing components in quartz ampoule.

The films prepared were found to save the composition of targets. The X-Ray Diffraction and Scanning Electron Microscopy in the surface and cross section regimes have indicated on a single phase chalcopyrite structure with <112> preferential orientation, columnar grain structure and surface morphology consisted of the densely packed grain smooth background and the spherical particulates. The optical and electrical measurements showed that the films had p-type conductivity with resistivities of 0.01 -10 Om*cm and bandgap equal to 1 eV. The influence of variation of beam parameters and growth conditions on the microstructural, electrical and optical properties has been investigated too.

Basing on the extensive characterization of $CuInSe_2$ films prepared we consider that the CuInSe2 thin films suitable for photovoltaic application can be fabricated by the pulsed electron beam ablation at the certain growth conditions.

CHARACTERISATION AND OPTIMISATION OF CADMIUM CHALOGENS AND ITO THIN FILMS FOR SOLAR CELLS

P.K. MENSAH and H. YAKUBU
Department of Physics,
University of Cape Coast, Cape Coast, Ghana

Abstract

Thin films of Cadmium Chalcogens and ITO have been successfully deposited using Stacked Elemental Layers (SEL) and spray methods respectively and also characterised by the study of their electrical and optical properties. It is established that the resistivity of deposited CdS films generally increases with increasing substrate temperature but decreases with increasing deposition rate. The optimal condition for deposition of ITO by the Spray-deposition method is established and in Cl_3 and $SnCl_4$ in the deposition solution. Films deposited from a solution of composition $(In_2O_3)_{1-x}(SnO_2)_x$ with x = 0.07 were found to have the best parameters with conductivity of 8.2×10^3 ohm^{-1} cm^{-1}, carrier concentration of 1.9×10^{21} cm^{-3}, mobility of $27cm^2V^{-1}s^{-1}$ and transmittance of 89% Improvements on the columnar growth and grain size of the grown CdTe films were achieved by treatment with the optimum concentration of 10g/l of $CdCl_2$ - MeOH solution. Fabricated devices from the films exhibited photovotaic behaviour with values for short circuit current density of 3.25 $mAcm^{-2}$, open circuit voltage of 537mV and Fill Factor of 0.36.

SPECTROSCOPIC AND STRUCTURAL STUDY OF CADMIUM SELENIDE THIN FILMS GROWN BY THE CHEMICAL BATH DEPOSITION TECHNIQUE

Amsata NDIAYE, Issakha YOUM

Laboratoire des semiconducteurs et d'énergie solaire
Faculté des Sciences et Techniques
Université Cheikh Anta Diop, Dakar Sénégal.

Abstract :

Cadmium selenide is an important II-VI semiconductor compound due to its application in electrooptics technology and solar cells devices and the chemical bath deposition provides an attractive, low cost method of producing cadmium chalcogenide thin films.

Cadmium selenide thin films have been deposited by a chemical bath deposition technique on indium tin oxide coated glass substrates from ammonia, triethanolamine or trisodium citrate cadmium complex ions and sodium selenosulfite. The deposition time were 40 minutes at 85°C and the deposited films are uniform and adherent to the substrate. The films were subsequently annealed at 250, 350 or 450 °C for 30 minutes after chemical treatment with saturated $CdCl_2$-methanol solution, and they have been characterized by a combination of photoluminescence and optical transmission spectroscopies and structural analysis : x-ray diffraction and scanning electron microscopy.

Photoluminescence spectra at low temperature of as-deposited samples show very weak in intensity but broad bands at ~ 1,71 eV and ~ 2,01 eV. Upon annealing, intensity of the band at ~ 1,71 eV increases as a result of an improvement in the crystalline quality of chemically deposited CdSe nanoclusters.

Transmission spectra at low and room temperatures show two absorption edges and an absorption tail probably caused by structural defects. It is also found that the position of the absorption edge is related to the complexing agent type. Transmittance of as-deposited and annealed samples are reduced by scattering losses by particulates overgrowth on the film surface as shown by SEM pictures.

X-ray diffraction patterns indicate that as-deposited films have very low degree of cristallinity, and an improvement in the crystalline quality of the samples after annealing is clearly seen. This indicates that heat treatment of the amorphous as-deposited films leads to a hexagonal phase of polycrystalline CdSe.

A Monte Carlo Percolative Approach

Reliability Analysis of Semiconductor Structures)

C. Pennetta , L. Reggiani

Istituto Nazionale di Fisica della Materia, Italy
Dipartimento di Scienza dei Materiali,
Universita' di Lecce,
Via Arnesano, I-73100 Lecce, Italy

This paper concerns a reliability analysis associated with the electrical degradation and failure of thin-film resistors due the stochastic generation of defects driven by local Joule heating. To this purpose a combined Monte Carlo percolative approach is used. The thin-film is modelled as a two-dimensional resistor network and its evolution is characterizeded by a breaking probability of the single resistor, which within the biased percolation model, is related to the substrate temperature and to the local joule heating averaged on first neighbour resistors. The dependence of each elemental resistance on the local temperature is also taken into account. The main properties of the film degradation are investigated, specifically: damage pattern, film lifetime, evolution of the film resistance and of the $1/f$ resistance-noise spectrum. Furthermore, the possibility of introducing a recovery of the degradation process, which blocks the percolation of the system and allows a stationary state, is also discussed.

The enhancement of CdS thin film properties for application purposes

D.Petre, L.Pintilie, E.Pentia, I.Pintilie, C.Tivarus, T.Botila

National Institute of Materials Physics
Bucharest-Magurele, P.O.Box MG-7, RO-76900, Romania

ABSTRACT

Cadmium sulphide (CdS) thin films were deposited on glass substrate by precipitation from aqueous solution technique. Different treatments on the CdS samples can improve the parameters of the thin films.

One part of the CdS samples were thermally annealed for 1 hour at 300^0C in different atmospheres: air, vacuum and argon. The CdS thin films thermally annealed in air, exhibit a high values of photosensitivity, explained by oxygen adsorption-chemisorbtion process. An increase in the dark resistance is observed for the CdS thin films thermally annealed in vacuum. These experimental results were explained considering an oxygen desorbtion process.

The films were doped with copper using two different methods: the dipping method and the direct method consisting of addition of a copper salt ($CuCl_2$) in the deposition CdS bath. The doped films were annealed for 1 hour in air, at 300^0C. It has been found that the dark resistance and photosensitivity of the films doped by dipping in a solution of a copper salt decreases as the dipping time increases. In the case when the copper salt solution is added directly into the deposition CdS bath, the dark resistance and the photosensitivity of CdS films increases as the copper content in the deposition bath is increased.

In conclusion, it is possible to choose those annealing conditions suitable for providing CdS films for specific applications such as solar cells, photodetectors, etc.

INDUSTRIAL APPLICATION OF COLOUR SOL-GEL FILMS

V.B. Prokopenko, D.V. Demianenko, I.M. Melnichenko

Gomel State University, 104 Sovetskaya St., 246699 Gomel, Belarus

The silica sol-gel films (SGF) doped with transition metals derived by spin-coating process on float glass substrate and silicon wafer were investigated. Precursor solutions were prepared by mixing tetraethylorthosilicate, ethanol, distilled water with molar ratio 1:7:10 and nitrates of the transition metals (Fe, Co, Ni and Mn), using chlorhydric acid as catalyst. Boric and phosphoric acids adding in sol were used for metals valency modification in SGF after heat treatment at 500 ^{0}C. Final solution showed suitable properties of viscosity and stability.

The typical thickness of SGF is about 0,3-0,6 μm. Good adherence to glass substrate was obtained for all sol-gel films. The general colour and transmission spectrum were measured for a float glass substrate coated with a sol-gel film. Different colours of SGF with varying hues (blue, yellow, olive, brown, orange) and intensities in according to type of doped transition metal oxides and modificators were received.

The uniform colour glass films derived by spin-coating process could be successfully used as solar eye protection. The sol-gel films were deposited on inner side of spectacle lenses by centrifugal method. Then lenses with SGF were finally annealed at 500 ^{0}C for 15 min. The reflection from coated surface of lens did not exceed 5% in visible range. Production of spectacle lenses with solar eye protected colour sol-gel films was developed at the Lida`s factory `OPTIC`.

The critical temperature in Ferroelectric thin films described by a transverse spin ½ Ising model

By

A. Saber, A. Ainane, F. Dujardin, M. Saber and B. Stébé

Abstract

The critical temperature in ferroelectric thin films described by a transverse spin –1/2 Ising model are studied using the effective field theory with a probability distribution technique. We discuss a L layer film of simple cubic symmetry with nearest-neighbor interaction in which the strengths of the interaction and transverse field are different from the bulk values in L_s surface layers, and we derive the phase diagram, the order parameter profiles and the susceptibilities. In such films, the critical temperature can shift to either lower and higher temperature compared with the corresponding bulk value. If the ratio of the surface interaction to the bulk ones is strong enough, there is still a phase transition to ferroelectricity even when the transverse field is larger than the bulk critical value. In surface-enhanced films with $L_s \geqslant 2$ the maximum in the order parameter profile occurs in the layers next to the outermost surface layer. The film longitudinal susceptibility diverges at the film critical temperature while the transverse one displays a cusp.

Magnetic properties of a transverse spin- $\frac{1}{2}$ Ising film

M. Saber[a], A. Ainane[a], F. Dujardin[b] and B. Stébé[b]
a) Université Moulay Ismail- Faculté des Sciences
Département de Physique- B.P. 4010- Meknès- Maroc
b) Université de Metz- Institut de Physique et d'Electronique
1 Boulevard Arago, 57078 Metz Cedex 3, France

Within the framework of the effective field theory, we examine the phase transitions of a transverse spin-1/2 Ising film. The critical temperatures of the film as a function of the [redacted] interactions, transverse fields and film thickness, are studied. It is found that for the ratio of the surface [redacted] interactions to the bulk ones $R = J_s / J$ less than a critical value R_c, the critical temperature T_c / J of the film is smaller than the bulk critical temperature T_c^B / J and as the film thickness L is increased further, T_c / J increases and approaches asymptotically T_c^B / J for large values of L. However, for $R > R_c$, T_c / J is larger both than the bulk T_c^B / J and the surface T_c^S / J critical temperatures of the corresponding semi-infinite system and as the film thickness L is increased further, T_c / J decreases and approaches asymptotically, for large values of L, the surface magnetic transition T_c^S / J observed in the corresponding semi-infinite system. We calculate also some magnetic properties of the film such as the layer magnetizations, their averages and their profiles and the longitudinal susceptibility of the film. The film longitudinal susceptibility still diverges at the film critical temperature, as does the bulk longitudinal susceptibility, but its magnitude is reduced. Also there is a rounded peak at the bulk critical temperature when $R > R_c$. The bulk-related character of the susceptibility is more pronounced and the surface-related character is less pronounced when the film thickness is large.

STUDIES OF ULTRA THIN FILMS QUENCH CONDENSED ON SOLID INERT GAS AND OTHER SUBSTRATES

G. SAMBANDAMURTHY, K. DAS GUPTA and N.CHANDRASEKHAR
Department of Physics, Indian Institute of Science, Bangalore 560 012, India

Disordered thin film systems have been studied over the last few decades because of the rich variety of physical phenomena one can understand. One method of preparing disordered thin films is by quench condensing metal vapours on to cryogenically (20K or less) cooled substrates.

We report an experimental study which shows that the electrical transport properties of these quench condensed films depend on the microstructure. The conductivity σ near the threshold conductance obeys a power law of the type $\sigma \sim (d - d_c)^{\mu}$ according to percolation theories in 2D. Here d is the thickness and d_c is the threshold thickness at which the conductivity appears.

Experiments have been done with Bi on bare substrate and with underlayers of solid Xe, Ge or Sb ($\sim$ 10Å) and at different deposition temperatures. Eventhough RHEED studies indicate that these films are either amorphous or nanocrystalline, it is very difficult to say how the microstructures change when the underlayers are changed.

The conductivity vs thickness plots clearly indicate the variation in the microstructure. The conductivity fits to a power law of the type mentioned with $\mu \sim 1.33$ only when a underlayer of Ge is used irrespective of the deposition temperature. This value of μ has been observed in many 2D systems near its percolation threshold. This suggests that the growth mechanism and microstructure are different in these films when the underlayer is changed.

This indicates that the underlayer plays a more active role in determining the macroscopic properties of the film rather than just increasing the wetting properties of the film on the substrate.

UDY OF SURFACE MICROSTRUCTURE OF MnO2 THIN FILMS BY SAXS

L. Skatkov

Ben Gurion University of the Negev, P.O.B. 653,
Beer Sheva 84105, ISRAEL

MnO_2 semiconductor films is an important material for application in thin films microelectronics device such as capacitor semiconductor-dielectric(SD) - interfase. For practical application of MnO_2 (prepared by thermal deposition of $Mn(NO_3)_2$) the characteristic of their submicropores (SMP) is critically important.

In the present work (the first for this material) the surface morphology, concentration and size distribution of SMP in semiconductor films were investigated by the scanning electron microscope (SEMD and the small-angle scattering X-rays (SAS).

Since the size distribution appeared to be polymodal, we classified the pores into four groups, according to thier size.

By the absence of noticeable anisotropy of the SAS the character of the dispertion indeces wich asymptotycally obey the law $I(s) - s^{-4}$, one can judge that scattering SMP's have no domineering orientation, and they are more equiaxial than macro- and micropores, which revealed by SEM.

It should be noticed that, unlike macro- and micropores, some of equiaxial SMP's are closed and filled with gas. Their formation is due both to clustering oxjgen vacancies shaped in MnO_2 coatings to the fact that the solidifying rate during the pyrolysis largely exceeds the gas emission rate, thus a part of the gas emitted is trapped in SMP's.

On the curve of the invariant of the dispersion indeces which reflects the distribution pattern of SMP's over their volumes one can see several maxima; this confirms that the distribution is polymodal, i.e. SMP's exist in several typical sizes. This can be a result of peculiarities of the process of pore formation involving gases and crystals.

INDIRECT EXCHANGE COUPLING AND SPIN POLARIZATION IN Fe/AlFe/Fe TRILAYERS

T.Ślęzak, M.Kubik, J.Korecki
Department of Solid State Physics, Faculty of Physics and Nuclear Techniques, University of Mining and Metallurgy, al.Mickiewicza 30, 30-059 Kraków, Poland

Al/Fe superlattices were grown by the alternate deposition of Al and Fe monolayers on a Fe(001) buffer layer on cleaved MgO(001) substrates. Magnetic and structural properties of the resulting $Fe^{57}Al$ films were checked *in-situ* (UHV conditions) by LEED and Conversion Electron Mössbauer Spectroscopy (CEMS). CEMS measurements proved that FeAl ordered alloy (CsCl - type) was formed. The $(AlFe)_n$ monoatomic superlattices were then used as non-magnetic spacers in $MgO(100)/FeI/(AlFe)_nAl_1/FeII$ trilayers. The thickness of the FeI and FeII layers was 20nm and 5nm, respectively. The growth mode of the trilayer was controlled by LEED and AES. A sharp (1x1) LEED pattern observed for FeI and FeII surfaces became diffused during the growth of the AlFe spacer. The number *n* of the double layers in the spacer was varied from 3 to 13 (0.9 - 3.8 nm). To exploit the isotopic resolution of CEMS some iron layers in the spacer made of Fe^{56} were replaced with the layers of Fe^{57}. The magnetic hyperfine field induced in the nonmagnetic spacer at the Fe^{57} nuclei, being a measure of the spin polarization from the ferromagnetic layers FeI and FeII, was investigated as the function of the Fe^{57} probe layer position in the spacer and the total thickness of the spacer layer. The magnetic hyperfine field data are correlated with the MOKE measurements, revealing a weak magnetic coupling between the FeI and FeII iron layers, dependent on the spacer thickness.

Snizhko L.O.

Microstructure and surface morpfological evolution in thin oxides films during electrochemical formation at the high voltage

Ukrainian State University of The Chemical Technology,
Dnepropetrovsk, Ukraine

Anodic spark deposition of inorganic coatings is a complex process, including stages of metal passivity, growth and breakdown of barrier oxide layer, and inorganic coating deposition. These processes are interconnected on the valve metals, and the opportunity of their realization depends on an applied voltage.

Oxides have different kinds of conductivity: valve metals oxides - mainly ionic, other ones - mainly electronic. In real systems both ionic and electronic currents flow simultaneously through oxide layer.

Oxide films conductivity is purely ionic for valve metals at low potentials or electronic for noble metals. In oxides with semiconductor properties (TiO_2) mixed conductivity is observed. The part of an electronic current can be rather significant in oxides with ionic conductivity at the large anodic potentials.

Stoechiometric titanium dioxide is an excellent insulating material with an energy gap of 3,2 eV and non-stoechiometric titanium dioxide presents oxygen vacancy levels near the conduction band, responsible for its n-type semiconductor behaviour.

The ionic conduction of the film, associated with the thickening of the anodic film represents approximately 15±5% of the total conduction. But, the electronic conduction of the film (85±5% of the total current) is responsible not only for the oxigen evolution and metal dissolution, but also for peroxide formation.

Some correlations may be observed between the kinetics of the different anodic reactions and some typical structures of the anodic films.

Thus, the cone structure may be correlated with the decrease of the efficiency of formation, no further increase in the concentration of the metal ion (Ti^{+4}) and the increas of the efficiency of the oxigen evolution. The stabilization of the Ti^{+4} concencentration suggests a mechanism of oversaturation of the electrolyte in the pits observed in the oxide film and percipitation of TiO_2 around these pits (cone structure) [1].

Another correlation may be observed between the microporous structure and the decrease of the forming efficiency. As proved by sparking and by the formation of the high temperature stable allotropic form of TiO_2 (rutile) in the microporous films, a high temperature is observed on the surface of the anode during breakdown.

The correlation between the kinetics of the anodic reaction and "epitaxial" films is more complex. The field strength determines speed of ion transition in oxide and indirectly - speed of an metal ion exit from oxide in solution. The oxigen composition of the oxide layer remains constant, and the border is displaced in the metal at the stationary conditions. Thus metal lattice is continuously renewed because of metal ions transition from oxide in solution and from metal in oxide.

Electrical breakdown plays a decisive role in formation of oxide crystalline structure. Different stages of electrolyze are accompanied by electrical discharges of various intensity and duration at the high - voltage anodization (350 - 500 V).

[1] Delplancke J.-L., Winand R. Galvanostatic anodization of titanium-11. Reactions efficiencies and electrochemical behaviour model//Elecrtochimica Acta. 1988. V.33.No.11. P.15551-1559.

Dielectric Response in CdTe thin films.

Abstract.

The optical dielectric function $\epsilon(E)$ of CdTe thin films implanted with different doses of oxygen at an energy of 100 KeV have been studied in the energy ~~en~~ range 1.6eV - 4.5 eV by spectroscopic ellipsometer. ~~The~~ As there is no concrete scheme to analyse the dielectric functions in irradiated films, ~~we~~ a phenomenological model is used to explain the data. In this, the dielectric function $\epsilon(E)$ is represented as a sum of harmonic oscillators in which all the oscillators have the same phase. The Spectral data reveals distinct critical points at E_0, $E_0 + \Delta_0$, E_1 and $E_1 + \Delta_1$. The effect of irradiation dose on the characteristics of the oscillator ie its energy, amplitude and spread will be discussed.

S. Tripura Sundari

Materials Science Division

Indira Gandhi Centre for Atomic Research

[illegible] 603 102

Photoconductivity and Optical Property of Silver Sulphide (Ag_2S) Thin Film For Solar Cell Application.

C. C. Uhuegbu[+] and K. A. Otaniyi
Department of Physical Sciences
University of Agriculture
Abeokuta
Ogun State
NIGERIA

Abstract

We have successfully grown and characterized Silver Sulphide thin film. The solution growth technique was used. Variation of thickness with different parameters such as – temperature, concentration, volume of complexing agent and time of deposition have been studied.

The Optical absorption Spectra was Studied Using Colorimeter Co75. Possible uses of Silver Sulphide thin film were also discussed.

[+] *Corresponding author.*

Hydrothermal-Electrochemical Preparation $Ba(Ti,Zr)O_3$ Thin Films from Ti-Zr Metallic Alloys on Silicon Substrate

Chang-Tai Xia, V. M. Fuenzalida, and R. A. Zarate

Universidad de Chile, Facultad de Ciencias Físicas y Matemáticas,

Departamento de Física, Casilla 487-3, Santiago, Chile

Abstract

Hydrothermal preparation of $Ba(Ti,Zr)O_3$ thin films from sputtered Ti-Zr metallic alloys on silicon substrate. A Ti-Zr 66:34 atomic% alloy target was used as the sputtering source. X-ray diffraction study indicated that a 4 hr. hydrothermal treatment in 0.5 M $Ba(OH)_2$ aqueous solution was enough for a ~50nm Ti-Zr alloy thin film on silicon substrate. A 2hr. treatment in 1 M solution or a 8 hr. treatment in 0.25 M solution resulted a similar degree of crystallinity, however the morphology, roughness, and cracks in the formed $Ba(Ti,Zr)O_3$ films are different from each other. XPS and SEM/XM analysis found that the Ti/Zr ratio in the prepared $Ba(Ti,Zr)O_3$ films were different from that in the sputtered Ti-Zr alloy films, which is further different from that in the source alloy. Preliminary capacitance measurement found that a dielectric constant of ~200 for a hydrothermal 300 nm $Ba(Ti,Zr)O_3$. This relative low value could be due to the poor density of the hydrothermal films.

Hydrotherma treatment results for the sputtered Ti-Zr alloys on silicon substrate from Ti-Zr 80:20 and 50:50 atomic% alloys sources, and electrochemical preparation of the $Ba(Ti,Zr)O_3$ thin films from the same types of alloys will be reported as a compare. And the on silicon substrate will also discussed. The formation mechanisms for these two preparation techniques will also be discussed.

Magnetization in magnetic multilayer Co/Cu system irradiated with 28 MeV proton

H.S.Zadeh, V.S.Tomar, S.Venkatesh* .and Shahnawaz†
Josephson Voltage and SQUID Division, National Physical Laboratory, New Delhi 110 012
*Nuclear Science Center, Aruna Asaf Ali Road, New Delhi 110 067
†Department of Physics and Astrophysics, Delhi University , Delhi 110 007

The magnetic multilayer Co/Cu system composed of alternate thin layers of Cu and Co is prepared on Si wafer by molecular beam epitaxy (MBE) technique. The layer thickness is varied from 100Å to 1000Å. The deposition parameters like the rate of deposition , substrate temperature and the level of vacuum are standardized in order to prepare high quality films. The degree of epitaxy is studied by the reflection high energy electron diffraction (RHEED) patterns. The films are subsequently irradiated with high energy (28MeV) proton beams having different fluences (10^{12} - 10^{14} ions/cm^2) which lead to the development of lattices. The role of such defects in modulating the interlayer magnetic exchange interaction, magnetocrystalline anisotropy and the magnetoresistance in such multilayer system is studied.From the observed patterns of variation in the saturation maggnetization M_S and the corresponding field H_S with the layer thickness we have calculated the magnetic domain wall energy while from the area between the perpendicular and parallel magnetic hysteresis curve and M-axis we have calculated the magnetic anisotropy energy K_U. By plotting $K_U(d_{Co}+d_{Cu})$ vs.d_{Co} (where 'd' is thickness of a layer) we could calculate the bulk and interface anisotropy K_v and K_s. The variation in these parameters with the radiation fluence is noted which helps in quantitatively estimating the extent of defects in the bulk and the interface region. Interestingly field and the coercive field have improved which are significant from the point of view of application of these multilayer as magnetic sensors. These observations highlight that it is possible to suitably modify the extent of radiation defects in order to improve the magnetoresistivity as well.

STUDY OF STRAIN IN PARTIALLY RELAXED Ge EPILAYERS ON Si(100) SUBSTRATE

Zuimin Jiang, Chengwen Pei, Xiaohan Liu, Dongzhi Hu, Jie Qin, Xun Wang
Surface Physics Lab. (National Key Lab.), Fudan University
Shanghai 200433, China, Email: ZMJiang@fudan.ac.cn
Quanjie Jia, Wenli Zheng, Xiaoming Jiang
BSRF, Institute of High Energy Physics, Beijing 100039, China

ABSTRACT

Ge epilayers of different thicknesses are grown by molecular beam epitaxy(MBE) with Sb as a surfactant on Si(100) substrate. X-ray diffraction illustrates that these Ge thin films are partially strained, and the strains decrease gradually with increasing epilayers thickness. Raman spectra reveal a downward shift of Ge-Ge mode peak with increasing thickness of epilayer. In the region of high strain, the relationship between Raman shift of this mode and the strain in the partially relaxed samples is great different from the linear relationship reported before. Possible reasons are discussed.