One Day National Meeting on

"Nanotechnology Research in PAKISTAN"

at Centre for Solid State Physics

August 03, 2010

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PROGRAMME &

ABSTRACTS

Agenda for the One Day National Meeting on
Nanotechnology Research in Pakistan
At Centre for Solid State Physics

August 03, 2010

8:30 am	Registration
9:00 am	Arrival of Chief Guest
9:05 am	Welcome Address (Prof. Dr. Shahzad Naseem, CSSP)
9:15 am	Inaugural address by the Chief Guest
9:30 am	Invited Talk on Nanotechnology research in Pakistan (Dr. Shahzad Alam, PCSIR, Lahore)
10:00 am	*TEA BREAK*

2nd Session

10:30 am	Nanotechnology research at UET (Prof. Dr. M. Khaleeq-ur-Rahman, UET, Lahore)
11:10 am	Nanotechnology research at CIIT (Prof. Dr. A.S. Bhatti, CIIT, Islamabad)
11:50 am	Nanotechnology research at CSSP (Dr. Saira Riaz, CSSP, Lahore)
12:45 pm	An experimental evidence of the hypothetical silicon dicarbide structure using molecular beam epitaxy (Prof. Dr. M. Asghar Hashmi, IUB, Bahawalpur)
1:00 pm	*LUNCH / PRAYER*
2:00 pm	LASER induced plasma as an X-ray source for material modification (Dr. M. Shahid Rafique, UET, Lahore)
2:15 pm	Influence of temperature on the structural and magnetic properties of $Co_{0.5}Mn_{0.5}Fe_2O_4$ ferrites (Shahid M. Ramay, CSSP, Lahore)

2:30 pm Molecular Dynamics study of nanowires and nanorods
(Razzaq Ali, IUB, Bahawalpur)

2:45 pm Effects of Ni incorporation on the surface and structural Properties of DLC composite films
(Arsalan Usman, UET, Lahore)

3:00 pm Effect of external magnetic field on the growth of Nano- structured $Zn_xMn_{1-x+y}Zr_yFe_{2-2y}O_4$ thin films
(Safia Anjum, UET, Lahore)

3:15 pm Plasma assisted CVD growth and characterization of DLC nano-structures
(Asfand Yar, CSSP, Lahore)

3:30pm TEA BREAK

3rd Session

4:00 pm Synthesis & characterization of ZnO nanoparticles through Sol-Gel route
(Robina Ashraf, CSSP, Lahore)

4:15 pm Synthesis and magnetic behavior of ZnMnO nano-crystallites
(Murtaza Saleem, CSSP, Lahore)

4:30 pm Molecular Dynamics study of surface diffusion at gold silver bimetal
(Muhammad Imran, IUB, Bahawalpur)

4:45 pm Preparation & characterization of Mn doped ZnO through sol-gel route
(Mehwish Bashir, CSSP, Lahore)

5:00 pm Electrodeposition of $L1_0$ Ordered $Co_{1-x}Pt_x$ NanoParticles and nanowires
(Rizwana Kausar, CSSP, Lahore)

Closing

5:15 pm Shields distribution

Current Situation of Nanotechnology Research at UET, Lahore

M. Khaleeq ur Rahman

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Email: khaleeq1953@gmail.com

Abstract

A technology that allows atoms and molecules of all the matter to be understood, imaged and manipulated is termed as nanotechnology. Its inception has opened a new era to improve abilities for the manipulation of materials for the betterment of humanity. Nanotechnology has grown explosively during the past few years, due to the realization that creating new materials and devices from nanostructure could access new improved properties and functionalities. Research in various fields of physics like Laser Matter Interaction/Laser Induced Plasma, Photonics/Optoelectronics/semiconductors and Nanotechology is carried out at Advanced Physics Laboratory (APL), Laser and Optronic Center (LOC) and Nanotechnology Research Center (NRC), UET, Lahore. Nanotechnology Research Center (NRC) at Physics Department UET, Lahore has been established to focus on precision engineering and tailoring of materials. Currently, experimental conditions for the fabrication of anodized aluminum oxide (AAO) nano-templates with pore diameter of 30 nm-200 nm have been optimized. Using the home-made nano-templates, magnetic nanowires are being fabricated by electrochemical method. Synthesis of magnetic nanotubes have been started and in progress. Various types of nano-particles are developed by using Nd:YAG laser and excimer laser. Chemical and pulsed laser deposition techniques are employed for nano-structured thin film fabrication. The present talk describes the various research activities being carried out under Physics Department at UET, Lahore.

Using nanoscience and technology for applications: Research direction in COMSATS Institute of Information Technology, Islamabad

Arshad Saleem Bhatti

Department of Physics, COMSATS Institute of Information Technology, Islamabad

The talk will consist of two parts. In the first part, the direction of research in the Department of Physics will be introduced. The facilities developed in recent years with their capabilities will be presented. Also included in this part will be, the research themes of some of faculty members will be introduced.

In the second part, results of some of the research being done in my group will be presented in a bit detail. This will include, gas sensing, biological sensing and surface charge modifications in shallow B **-** implanted Si studies using PR spectroscopy.

Nanotechnology research at Centre of Excellence in Solid State Physics

Saira Riaz

COE in Solid State Physics
Punjab University, Lahore

Abstract:

In this talk an overview of the nanotechnology research being carried out at the Centre of Excellence in Solid State Physics will be presented. Basically, 3 different preparation techniques are being used for nano-growth, namely: Sol-Gel, Electrolytic Deposition and Plasma-assisted Chemical Vapour Deposition. The plasma-assisted CVD technique is used for growth of various types of carbon nano-structures and it will be shown in this overview that nanotubes, nanowires, nano-diamonds and alike structures can be routinely formed by controlled deposition, as shown in Figs. 1-4.

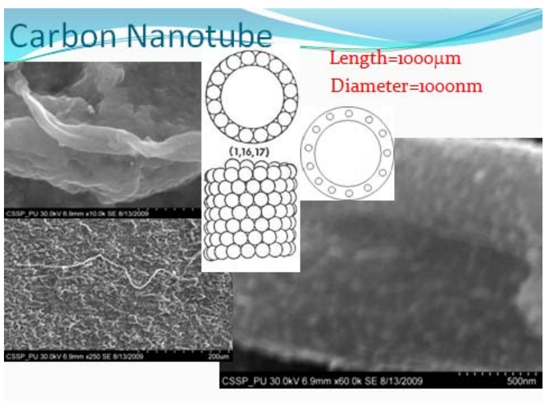


Fig. 1:

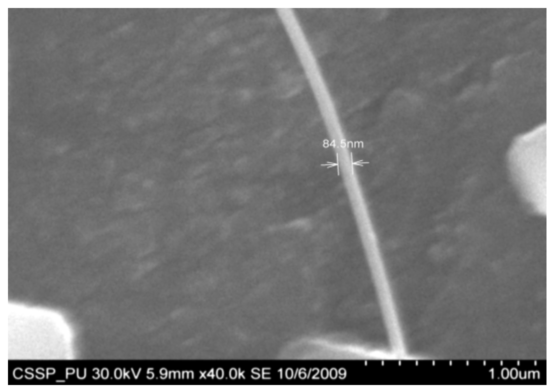


Fig. 2:

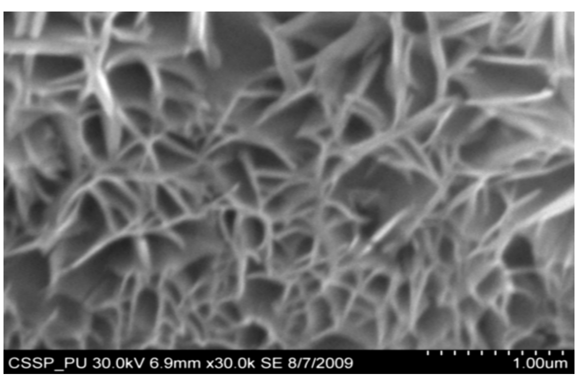


Fig. 3:

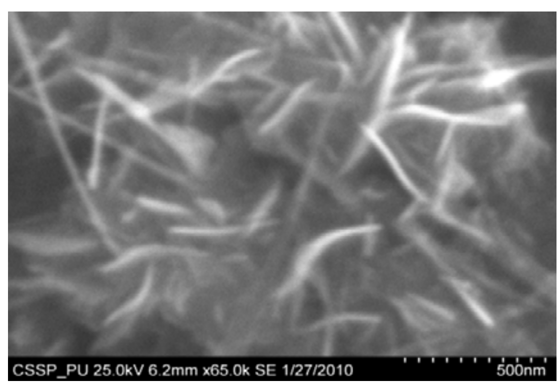


Fig. 4

The Sol-gel technique is used for deposition of oxides and nitrides of various materials. It has been found that nanrods and nanotubes type of structures exist in ZnO deposited by sol-gel technique.

These materials also exhibit magnetic properties without any intentional doping. Some of the structures are shown in Figs. 5-6 which show scanning electron micrographs.

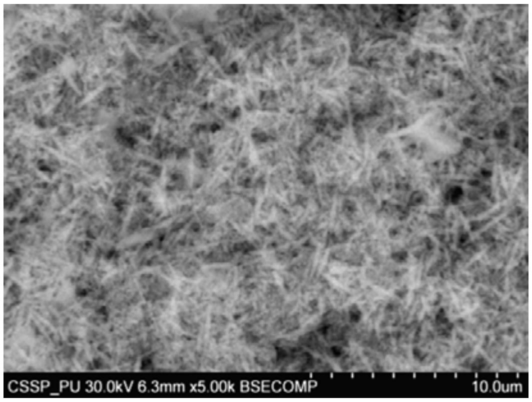


Fig. 5:

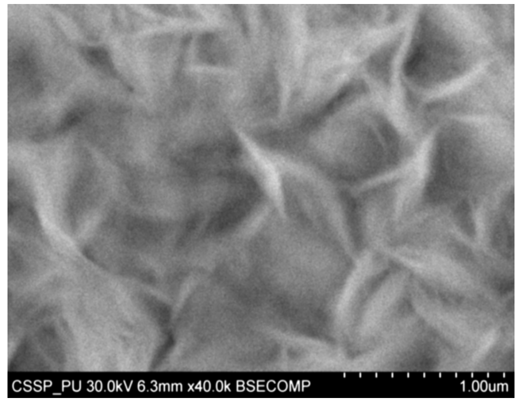


Fig. 6:

A representative surface characterization using Atomic Force Microscopy (AFM) is shown in Fig. 7 showing an average roughness of around 20 nm.

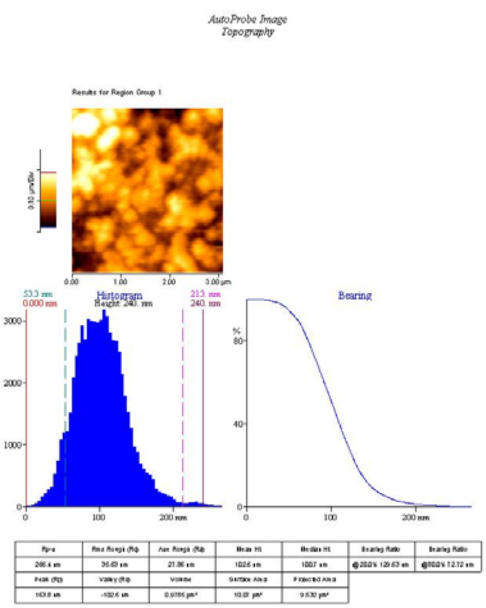
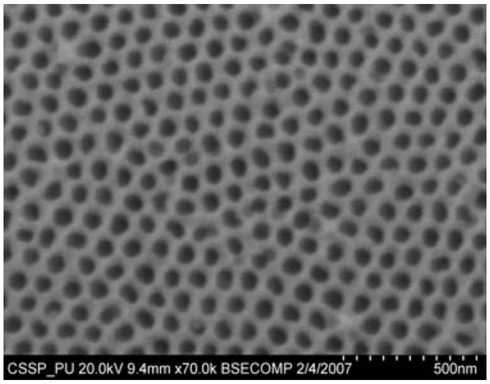


Fig. 7

The group is also actively involved in Anodic Aluminum Oxide (AAO) template formation and filling the pores with electro-deposition. Fig. 8 shows one view of an AAO template with pore diameter of around 50nm, whereas Fig. 9 shows magnetic nanowires grown with template assisted technique.



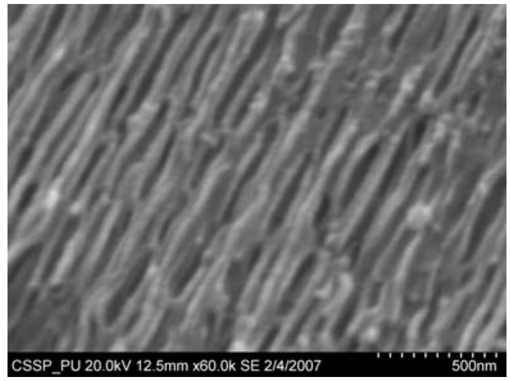


Fig. 8:

Fig. 9:

The electro-deposition technique is also being used for study of compound magnetic materials' growth. Nano-particles are deposited by this technique in a routine matter and some of the images are shown in Fig. 10.

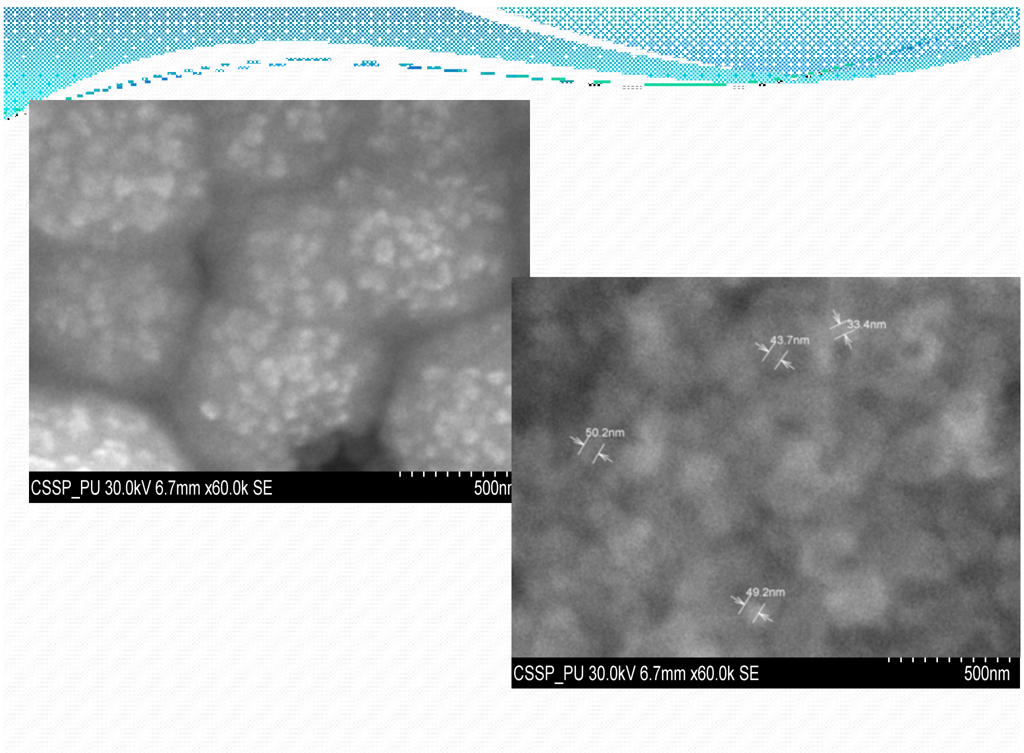


Fig. 10:

It is not only the nano-structures that are being formed and studied at the Centre, these materials are successfully utilized in various devices and applications. Fig. 11 shows a transmission plot through glass when coated with 3 layer antireflection coating. It is clear that the reflection from glass surface reduces from 4% to around 0.01% by the use of optimized nano-materials. Fig. 12 shows the results of a minus filter fabricated using 32 layers of nanostructures. The edge view of this filter is shown in

Fig. 13 whereas the surface AFM image is shown in Fig. 14 both showing that the devices are being made out of nano-particles.

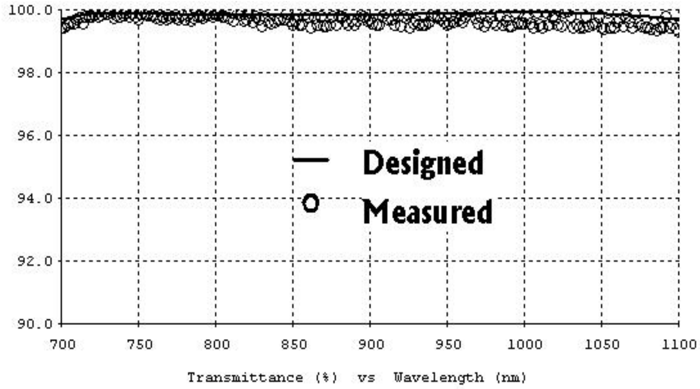


Fig. 11:

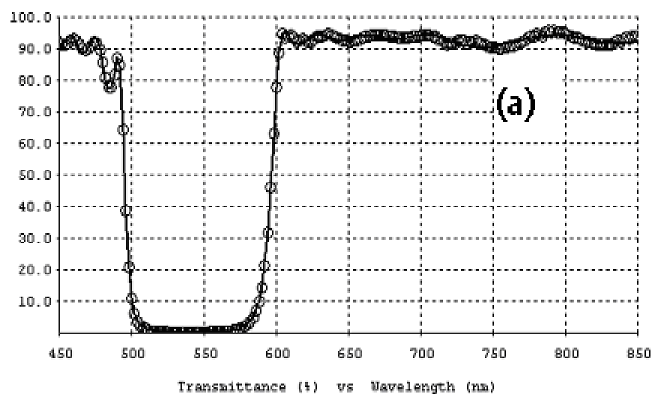


Fig. 12:

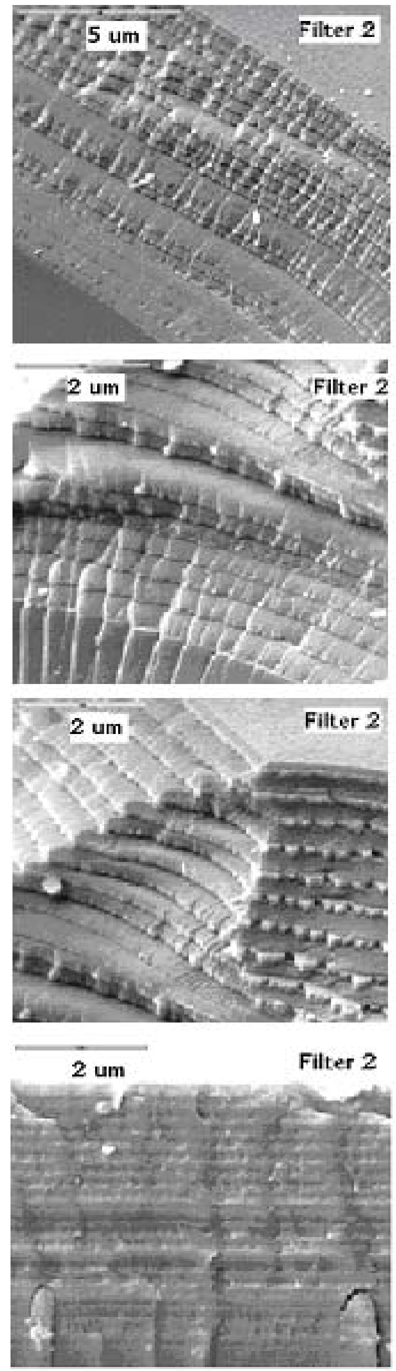


Fig. 13:

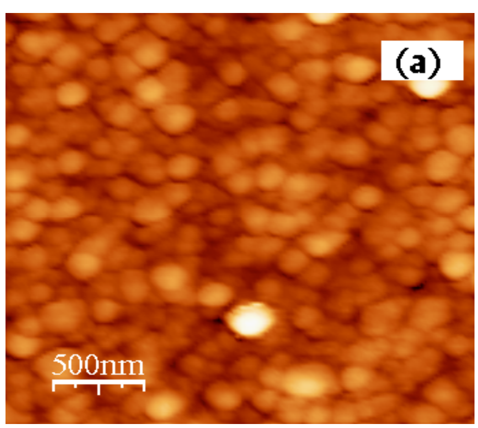


Fig. 14:

An experimental evidence of the hypothetical silicon dicarbide structure using molecular beam epitaxy

M. Asghar[1], Adnan Ali[1], W. Sitaputra[2], Lu, Na[2] and Raphael Tsu[2]

[1] Department of Physics, The Islamia University of Bahawalpur, Pakistan

[2] Department of Electrical and Computer Engineering, University of North Carolina at Charlotte, USA

Abstract

M. J. Bucknum and R. J. Hoffman have proposed a new hypothetical structure, described with the chemical formula SiC_2 like the parent carbon allotrope glitter [(1994). J. Am. Chem. Soc., 116, 11456.]. Silicon dicarbide is a tetragonal structure with a=3.07A ° and c=7.02A ° and lies in space group $P4_2/mmc$, with 6 atoms in the unit of pattern and 2.61 g/cm^3 density. The elementary cell of silicon dicarbide is shown in Figure 1. In this presentation, we present an experimental evidence of the so-called hypothetical SiC_2 structure using molecular beam epitaxy (MBE) growth technique. Fullerene (C_{60}) and Silicon (Si) were evaporated for 4 hours on Si(111) target maintained at1050^{o}C in MBE chamber. The temperature of C_{60} effusion cell was 600^{o}C and Si was evaporated by ebeam facility. Fourier transform infrared (FTIR), x-ray diffraction (XRD), RAMAN scattering and scanning electron microscopy/energy dispersive x-ray spectroscopy (SEM/EDAX) techniques were used to confirm the practical existence of SiC_2.Owing to different lattice constant from SiC, the SEM/EDAX images of SiC_2 standout as rods (see figure 2). The EDAX yields At% ratio of Si:C as 33:66 which is exactly 1:2 and thereby confirms the stiochiometric SiC_2.

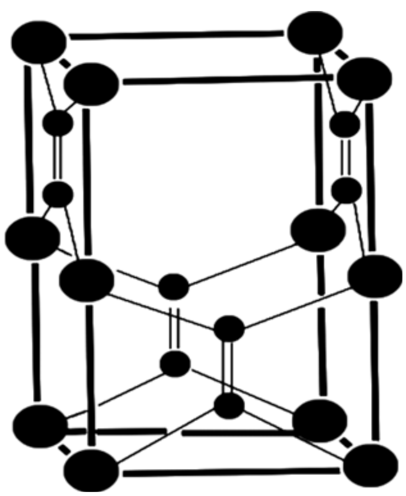


Figure 1. Elementary unit cell of SiC_2

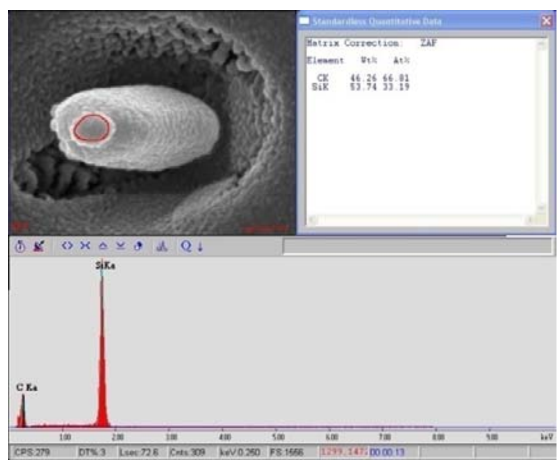


Figure 2. Self-explanatory SEM/EDAX image of SiC_2

Laser induced plasma as an X-ray source for material modification

Hamid Latif[1], M. Shahid Rafique[1], M. Khaleeq-ur Rahman [1] and S. Naseem[2]

1. *Physics Department, UET, Lahore*
2. *Centre for Solid State Physics, PU, Lahore*

In the project an attempt has been made to use the laser-induced plasma as an X-ray source for the growth of nanostructures on the surface of Gold. For this purpose, an Nd:YAG laser operated at second harmonics (λ = 532 nm, E = 400 mJ) is used to produce plasma from analytical grade 5N pure Al, Cu and W targets. An analytical grade (5N pure) Gold substrate was irradiated by X-rays generated from Al, Cu and W plasma under the vacuum ~ 10^{-4} Torr. The structure and surface were analyzed by four techniques, XRD, SEM AFM and TEM. The aberrations in the XRD peaks show that there are significant structural changes in the exposed metals, in terms of decreased reflection intensities, increased dislocation line density, changes in the d-spacing and disturbance in the periodicity of the planes. The XRD pattern (only in case of W as an x-ray source) is shown in figure 1 and complete XRD data are summarized in table 1.

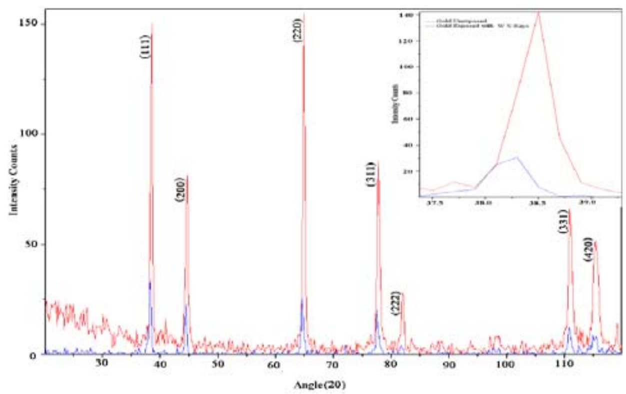


Figure1: XRD patterns of unexposed and exposed gold samples by X-rays emitted from W along with magnified peak of hkl (111).

Substrate	Exposure	X-rays Source	I_p (Counts)	d Spacing (A°)	2θ Degree	Grain size D nm D= k λ / βcosθ	Dislocation Line Density 10^{14} Lines/m^{-2} σ=1/(D)^2
Au	Un-exposed	-	269.79	2.34	38.35	149.11	44.98
Au	Exposed	Al	64.07	2.33	38.38	148.00	45.03
Au	Un-exposed	-	292.96	2.34	38.35	149.04	45.01
Au	Exposed	Cu	83.06	2.33	38.38	148.05	45.03
Au	Un-exposed	-	306.14	2.35	38.17	149.08	44.99
Au	Exposed	W	64.95	2.34	38.47	148.95	45.08

TEM Images in figure 2 (only in case of W as an X-ray source) supplement the XRD results showing that grain size was decreased after the exposure to X-rays.

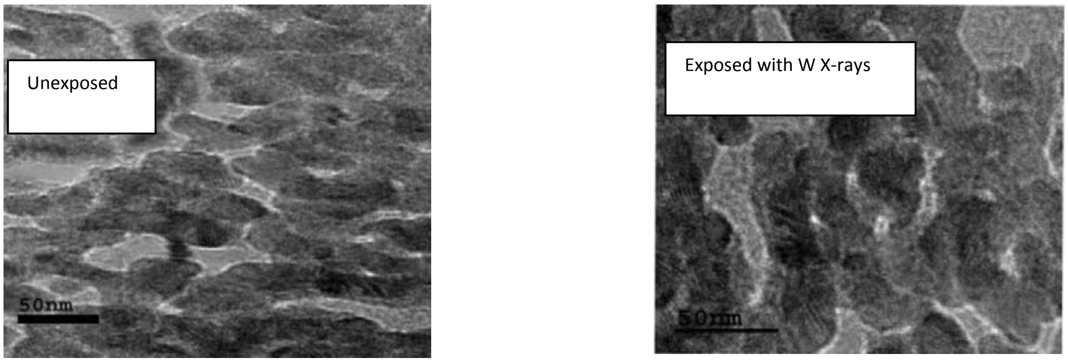


Figure 2: Bright field TEM micrographs exhibiting grains on the gold unexposed surface and gold surface irradiated by X-rays produced from W target along with the statistic grain size distribution derived from

SEM and AFM used to explore the surface morphology and topography of the irradiated metals reveal that regardless of the source, nm sized hillocks have been produced on the surface of the metal. The roughness of the surface has increased due to the growth of these hillocks. The AFM micrographs in figure 3 exhibits the growth of nano hillocks on the gold surface in response to the X-rays emitted from the W target.

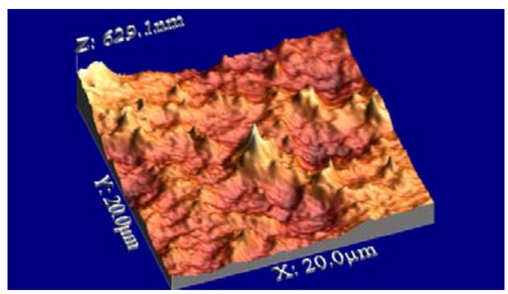


Figure 3: Hillocks formation on Au irradiated by X-rays produced by W

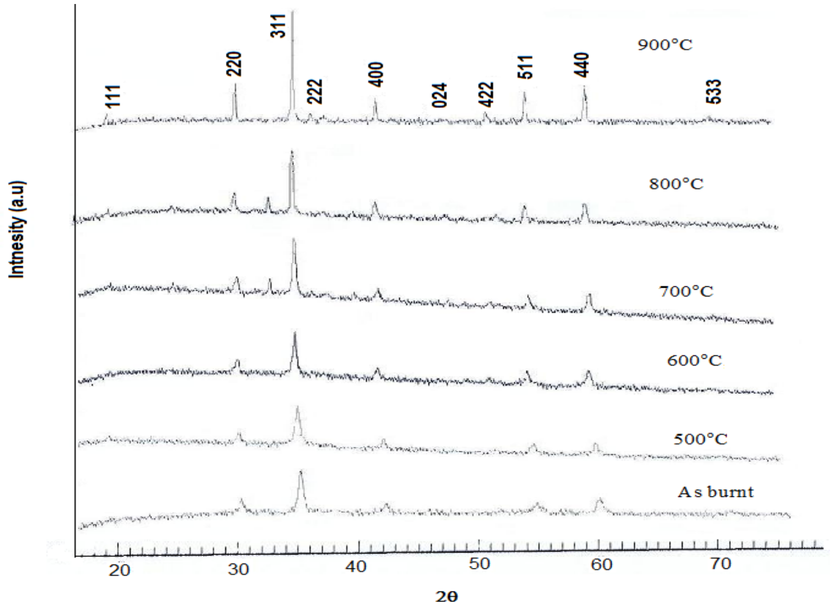
Influence of temperature on the structural and magnetic properties of $Co_{0.5}Mn_{0.5}Fe_2O_4$ ferrites

S.M. Ramay, S. Atiq, Saadat A. Siddiqi, S. Naseem

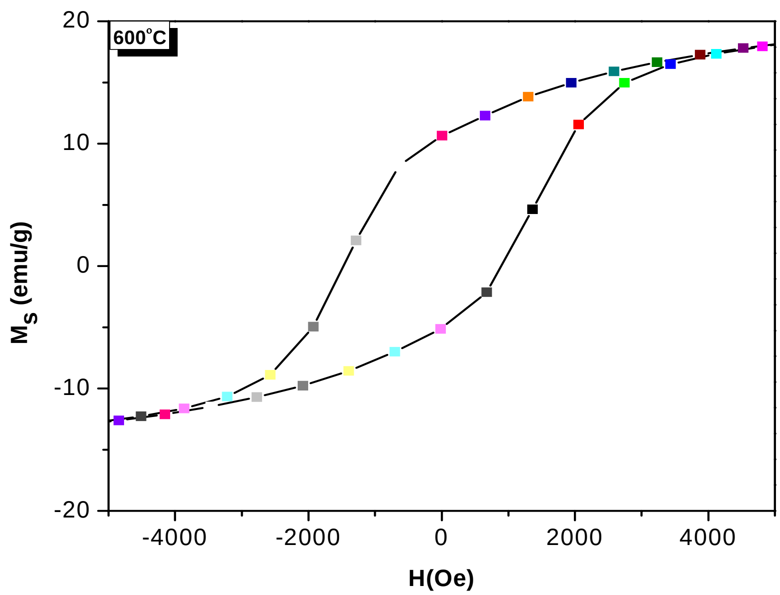
Centre for Solid State Physics, Punjab University, Lahore-54590, Pakistan.

Abstract

$Co_{0.5}Mn_{0.5}Fe_2O_4$ ferrites have been synthesized using single-step sol-gel auto-combustion method in which the metal nitrate (MN) to citric acid (CA) ratio and pH were adjusted to 0.5:1.0 and 7 respectively. The structural and magnetic properties of as-burnt powder have been studied as a function of temperature. The inverse spinel structure was confirmed by X-ray diffraction (XRD) analysis and crystallite size was estimated by the most intense peak (311) using Scherrer's formula. Contrary to previous work, both as-burnt and annealed samples exhibit crystalline behavior. Room temperature magnetic properties were carried out with vibrating sample magnetometer (VSM) with field strengths up to 10 KOe. It is observed that lattice parameters and crystallite size increase with the increase in temperature. Maximum coercivity (1470 Oe) was obtained at 600°C with an average crystallite size 23 nm.



XRD patterns of $Co_{0.5}Mn_{0.5}Fe_2O_4$, as-burnt and calcined at 500,600, 700, 800 and 900°C



Room temperature M-H curve shows maximum coercivity of about 1470 Oe with an average crystallite size 23 nm was obtained at 600°C

Molecular Dynamics study of nanowires and nanorods

Razzaq Ali

Department of Physics
The Islamia University Bahawalpur

Email: razzaqalibwp@yahoo.com

ABSTRACT

Atomistic simulation of tensile loading of (100) nanorod have been performed by using Embedded Atom Method (EAM), to study the mechanical behavior of silver (Ag) and gold (Au) at nanoscale. For this purpose a well established Molecular Dynamic (MD) simulator '*dyn* 86' containing DYNAMO subroutine has been used. In the present work we study that the (100) orientation of square cross sectional Ag and Au nanorod transforms into a series of stable ultra thin single-walled hexagonal (m,n) nanowire with a linear stand at the centre due to uniaxial tensile loading at low temperature. The nanowires of (m,n) geometry can also be created by folding (111) rectangular lattice atomic sheet of Ag and Au by placing a stand rod at the centre. Then finally the mechanical behavior of (m,n) nanowires one that is formed by applying tensile loading on nanorod and other that is created by folding (111) rectangular lattice atomic sheet are compared after relaxation. It is observed that the mechanical behavior of both, show approximately similar results for yield strength etc. We anticipate from these results the application of single walled hexagonal nanowires even with diameter of approximately ~ 2nm in nano-electronic devices.

Effects of Ni incorporation on the surface and structural Properties of DLC composite films

Arslan Usman [a], M.S. Rafique [a], M.Khaleeq-ur-Rahman [a], K. Siraj [a], S. Anjum [a], H. Latif [a], Taj. Muhammad Khan [b]

[a] Physics Department, University of Engineering & Technology Lahore 54890-Pakistan

[b] National Institute of Laser and Optronics (NILOP). P.O. Nilore Islamabad- Pakistan

Abstract

The structure and surface morphology of Ni-incorporated diamond like carbon (Ni:DLC) films have been investigated. These films were deposited on Si substrates by using Pulsed Laser Deposition (PLD) technique. A KrF Excimer laser ($\lambda = 248nm$) was used for co-ablation of multi-component Ni-graphite target. The concentration of Ni was varied by ablating the Ni part of the target with various number of laser pulses. The SEM and AFM micrographs as shown in figure 1 & figure 2 respectively, reveals that the surface is composed of segregates of Ni which increases with the increase in Ni content during the growth process.

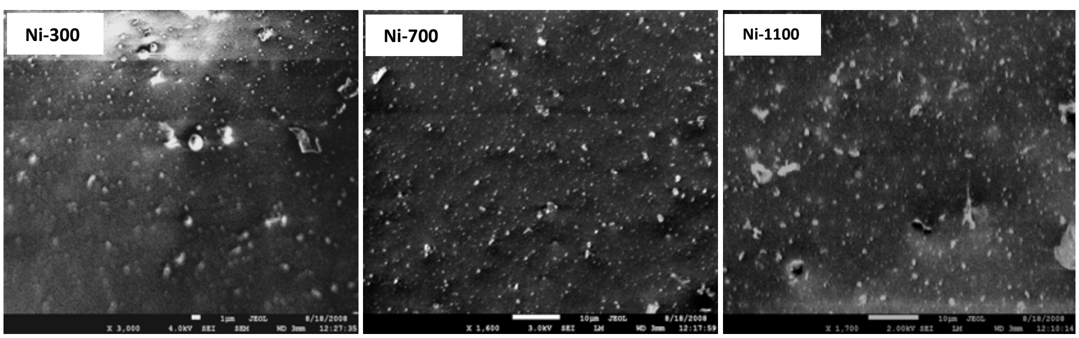


Figure 1: SEM micrographs of the deposited Ni-graphite Films by varying number of laser pulses for Ni

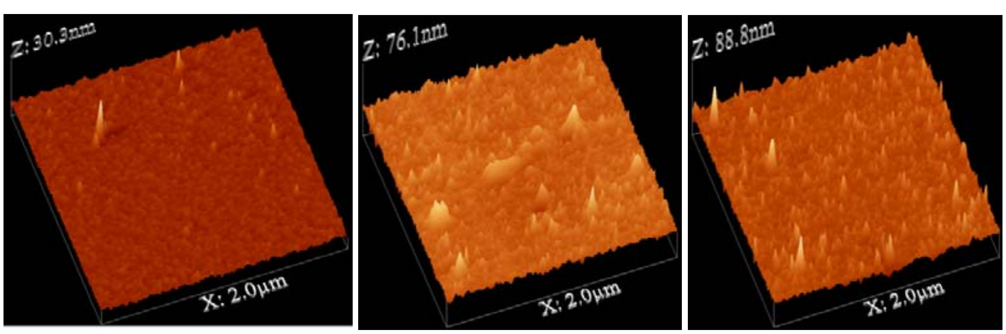
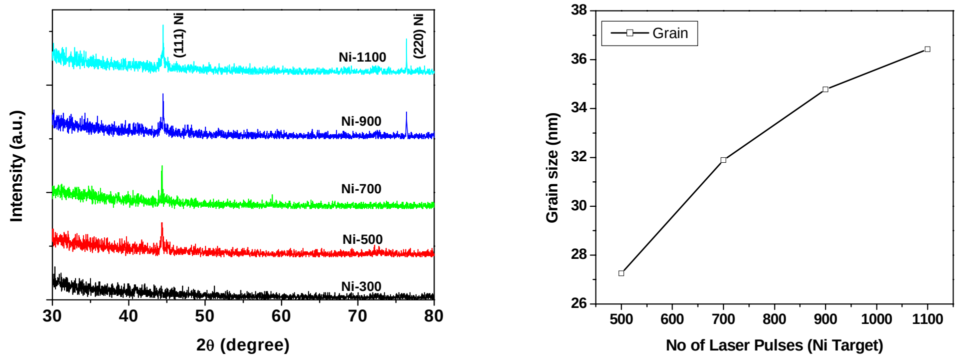


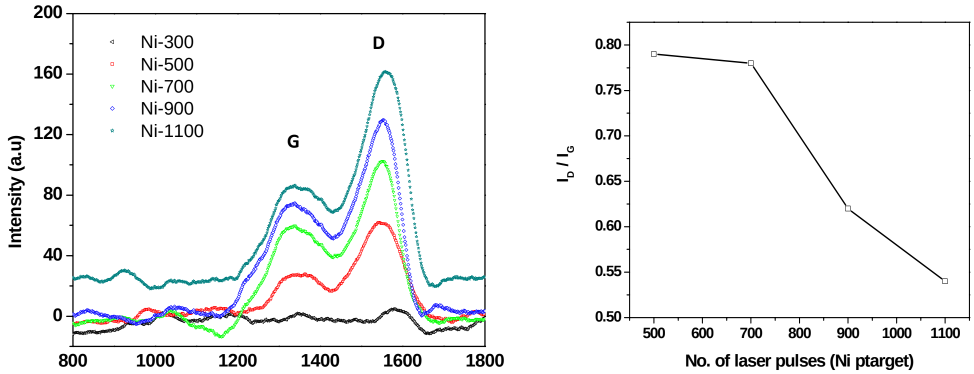
Figure 2: 3D AFM micrographs of Ni:DLC films deposited at Si substrate.

The structural investigations by XRD and Raman spectroscopy (figure 3 & 4) provided information about the orientation of the incorporated constituent and the ordering of the carbon species. Maximum height of the compact nano structures which were observed on the surface was ~52 nm.



(a) (b)

Figure 3: (a)-XRD spectra (b)-variation in Grain size of the deposited films



(a) (b)

Figure 4: (a)-Raman Spectra (b)- I_D/I_G ratio of the deposited Ni:DLC films

The G-peak of the graphite was shifted towards higher wavenumber due to enhancement in SP^2 sites which have been increased due to the increase in the Ni concentration.

Effect of external magnetic field on the growth of Nano- structured $Zn_xMn_{1-x+y}Zr_yFe_{2-2y}O_4$ thin films

Safia Anjum[*,a], M. Shahid Rafique[a], M. Khaleeq-ur-Rahaman[a], Khurrum Siraj[a] S. Naseem [b], Aisha Ahsan[a], Arslan Usman[a]

[a] *Advanced Physics Laboratory, Department of Physics, University of Engineering and Technology, Lahore 54890, Pakistan.*
[b] *Microelectronics Centre University of the Punjab Lahore.*

Abstract:

$Zn_{0.2}Mn_{0.81}Zr_{0.01}Fe_{1.98}O_4$ and $Zn_{0.2}Mn_{0.83}Zr_{0.03}Fe_{1.94}O_4$ thin films with different concentration of Mn and Zr have been deposited on single crystal n-Si (400) at room temperature (RT) by pulse laser deposition technique (PLD). The films are deposited under two conditions; with applied external magnetic filed transverse to the direction of propagation of the plume and without field. XRD results show (figure 1) the films have spinel cubic structure when deposited in the presence of magnetic field.

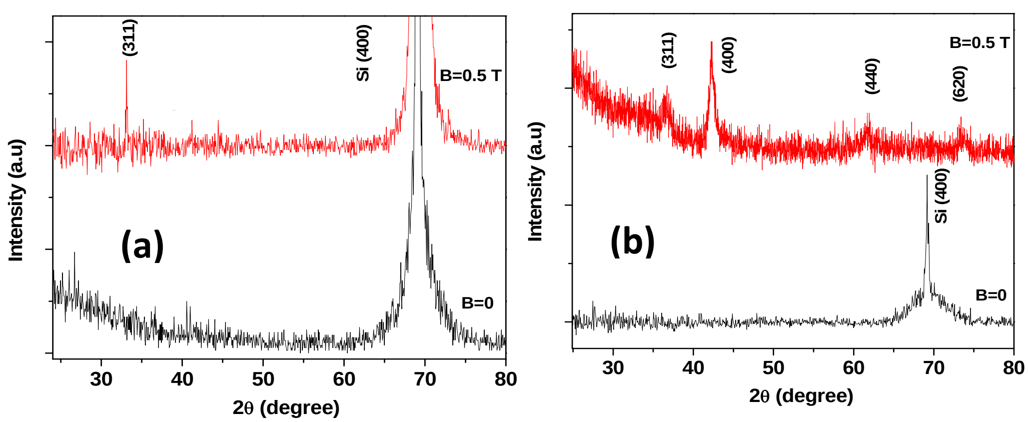


Figure 1: XRD pattern of thin films (a) with and without B field of target X (b) with and without field of target Y (a) B=0 (b) B=0.5 Tesla

Scanning Electron Microscope (SEM) (figure 2) and Atomic Force Microscope (AFM) (figure 3) observations clearly show the effect of external applied magnetic field on the growth of films in terms of small particle size, improved uniformity and lower r.m.s. roughness.

The average grain size measured from SEM for sample X and Y under the influence of external magnetic field is 86 nm and 96 nm respectively, where without field is 110 nm and 130 nm.

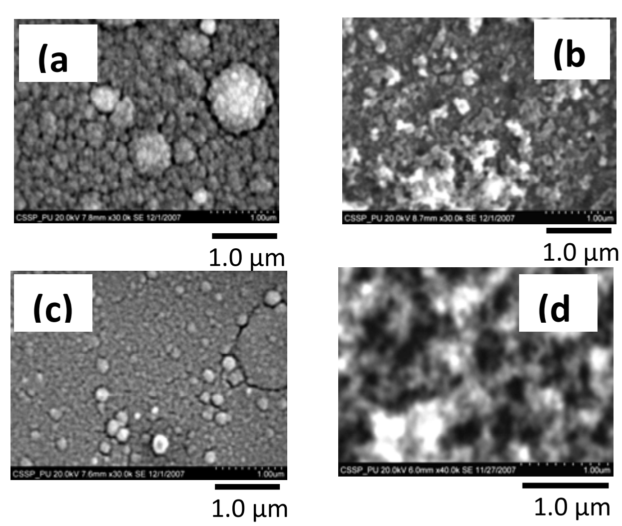


Figure 2: SEM images of thin films of (a) sample X with B field (b) sample X without B field

The r.m.s roughness of the thin films with field is 12 and 3 nm for the sample X and Y respectively

The r.m.s roughness of the thin films w.o 44 and 22 nm

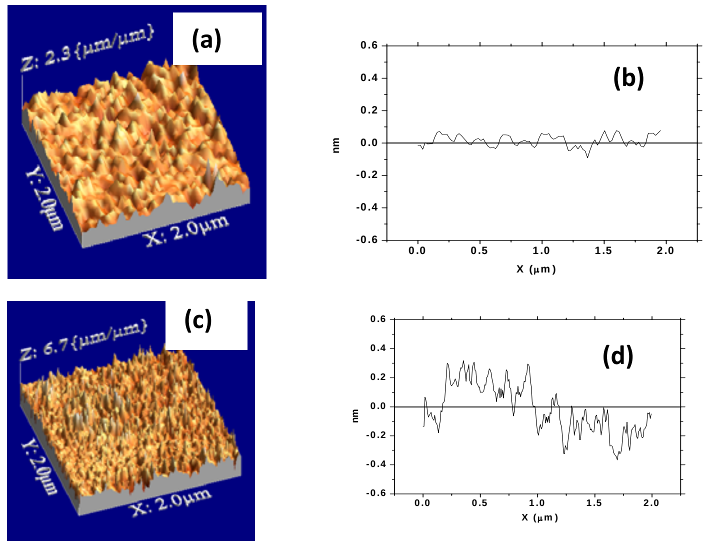


Figure 3: AFM 3-D view and Y average filter of Thin films of sample X and Y on n-Si substrate (a,b). Sample X with field (c,d). sample X without field

Thin films deposited under the influence of external magnetic field exhibit higher magnetization as measured by the VSM.

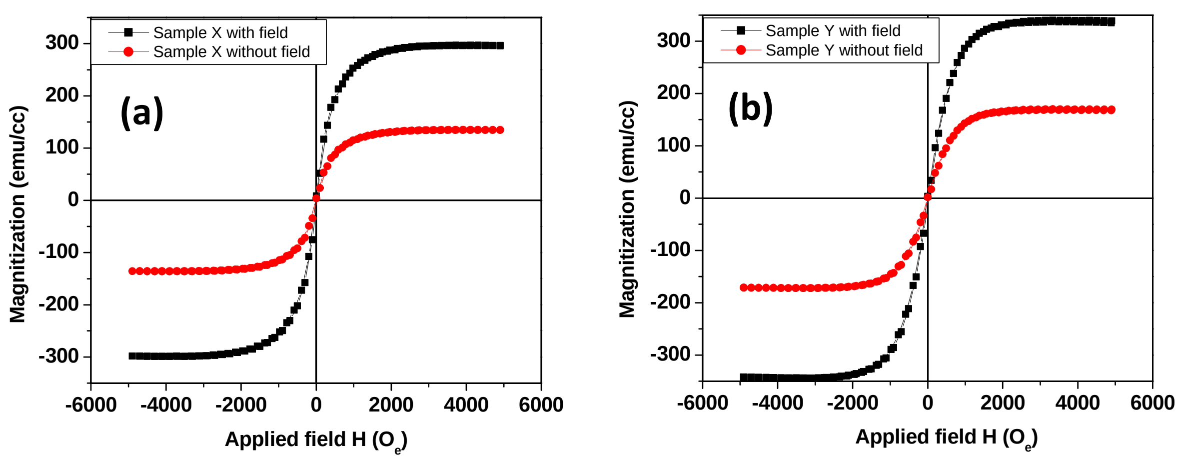


Figure 4: MH loop of thin films (a) with and without B field of sample X

Plasma Assisted CVD growth and Characterization of DLC Nanostructures

Asfand Yar, Muhammad Yasir, Muhammad Noman Iqbal, Saira Riaz and Shahzad Naseem*

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*School of Physical Sciences, Punjab University

ABSTRACT:

In this paper, we report diamond like carbon (DLC) nanostructure formation by using plasma-assisted CVD technique. The apparatus (home-made) details can be seen in Fig. 1. The experimental conditions were all varied in order to optimize the structures. Under optimized conditions, it has been found that nano-wires and nano-grains can be formed onto stainless steel substrates. The SS substrate provides the essential catalyst materials for such carbon growth. The 2 types of steels used are given in Fig. 2 along with the quantities of Ni and Mn. The resulting structures are evident in Figs. 3-5. In this work electrical properties of these carbon nano-structures were also investigated and it was found that both conducting and insulating materials can be obtained as shown in Figs. 6-7.

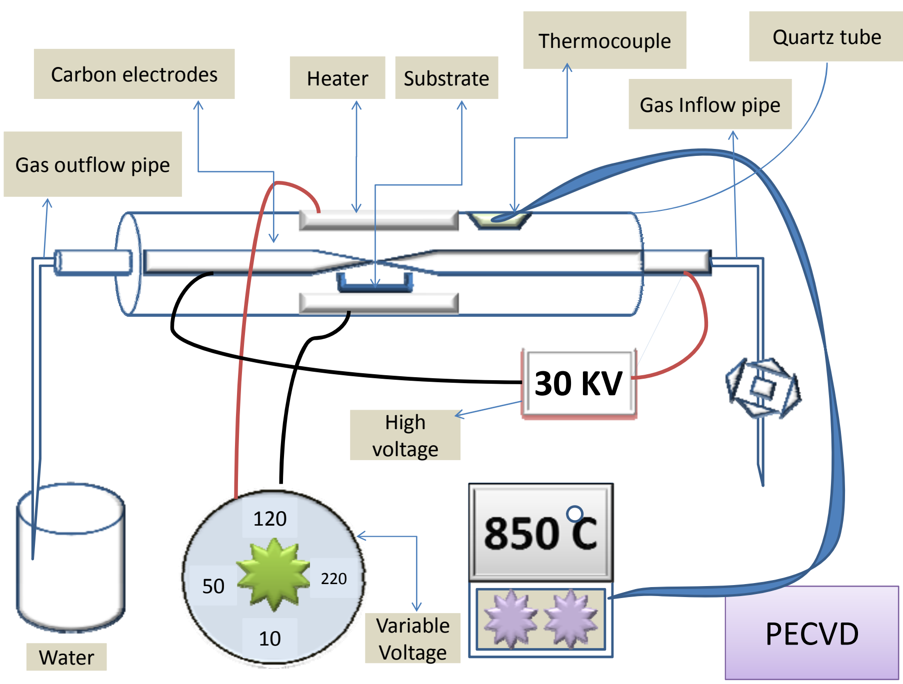

Fig. 1:

Fig. 2:

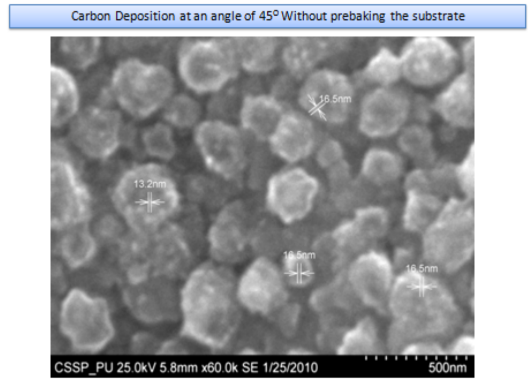

Fig. 3:

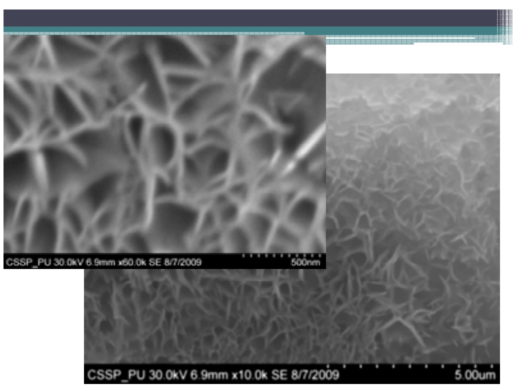

Fig. 4:

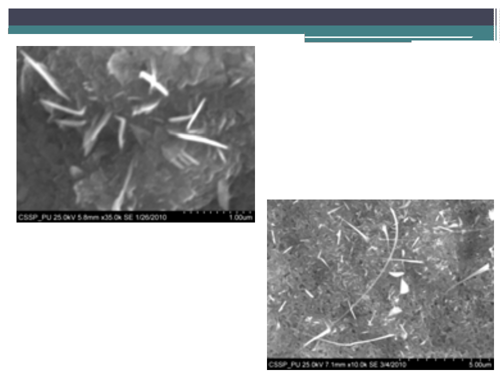

Fig. 5:

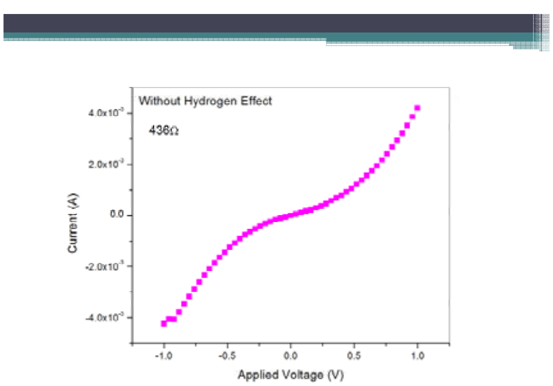

Fig. 6:

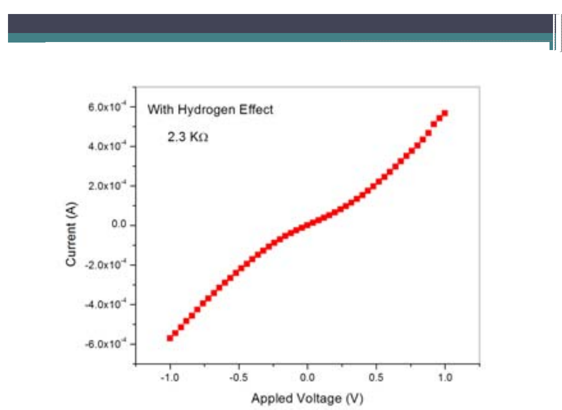

Fig. 7:

Synthesis and magnetic behavior of ZnMnO nano-crystallites

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[b]*School of Science and Engineering (SSE), Lahore University of Management Sciences (LUMS), Opposite Sector U, D.H.A. Lahore-54792, Pakistan*

Abstract

Mn doped ZnO nano-crystallites were synthesized by state of the art sol-gel derived auto-combustion technique. As-burnt powder was investigated with different characterization techniques to explore the properties of Mn doped ZnO dilute magnetic semiconductor (DMS). X-ray diffraction (XRD) measurements indicate that Mn doped ZnO retain wurtzite type hexagonal crystal structure like ZnO. Compositional and morphological studies were carried out by Energy Dispersive X-ray (EDX) analysis and Scanning Electron Microscopy (SEM), respectively. Temperature dependent resistivity of the sample exhibited the characteristic semiconducting behavior of the DMS material. Room temperature magnetic properties determined by vibrating sample magnetometer (VSM), revealed the presence of ferromagnetic and diamagnetic contributions in Mn doped ZnO.

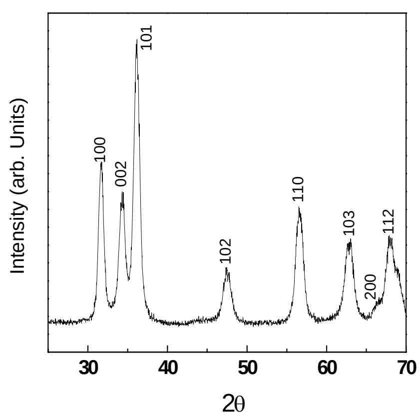


Figure 1 XRD spectrum of $Zn_{0.95}Mn_{0.05}O$

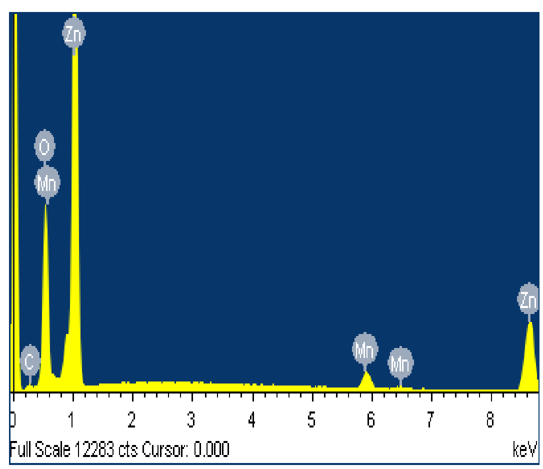
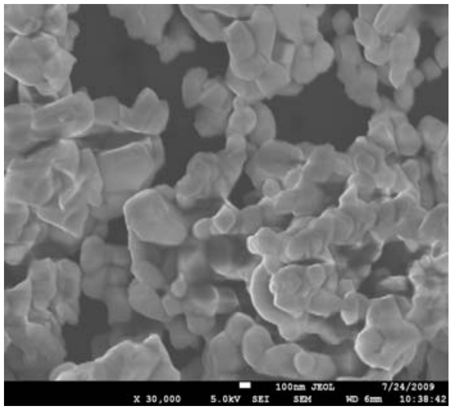


Figure 2 EDX spectrum of $Zn_{0.95}Mn_{0.05}O$



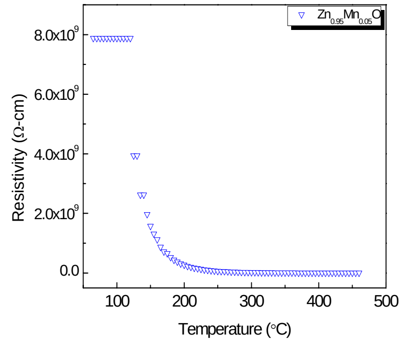


Figure 3 SEM micrograph of $Zn_{0.95}Mn_{0.05}O$

Figure 4 Temperature dependent Resistivity

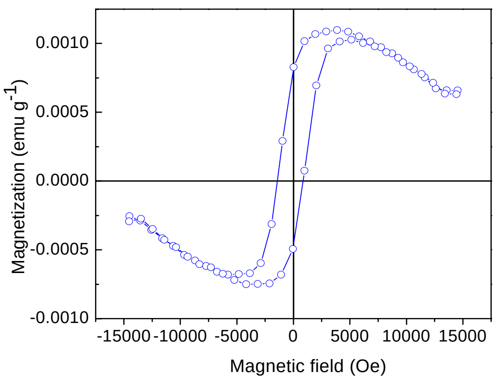


Figure 5 Field dependent Magnetization of $Zn_{0.95}Mn_{0.05}O$

Molecular Dynamics study of surface diffusion at gold silver bimetal

Muhammad Imran

The Islamia University of Bahawalpur
Bahawalpur

Abstract

A molecular dynamics simulation has been applied to study the mechanism of surface diffusion. For this purpose a well established molecular dynamic simulator 'dyn86' containing subroutine DYNMO has been utilized. Semi empirical potentials based on the embedded atom method (EAM) potentials have been employed for the study of Ag monomer and dimer add atom on (111) surface of Ag, Au and Au-Ag bimetal. It is observed that the add atoms hope and jump at the surface from FCC sites to HCP sites and back from HCP to FCC sites and approximately traces a series of hexagon. The diffusion coefficient of add atoms on the surface are determined at different pure and bimetallic configurations at 300, 500 and 700 K and effect of temperature on the diffusion rate is investigated. It is observed that the diffusion rate increases with the increase in temperature. The effects of different bimetallic configurations on the diffusion rate are also observed and hence the effective energy barrier and the diffusion prefactor are calculated. Using molecular dynamics simulation, the effect of temperature on the mechanical strength and deformation of nanowire is also studied. It is found that yield strength varies approximately linearly with the increase in temperature, and brittleness and elastic modulus of the nanowire are also decreased.

Preparation and Characterization of Mn doped ZnO through Sol gel technique

Mehwish Bashir, Shumaila Islam, Saira Riaz and Shahzad Naseem

Centre of Excellence in Solid State Physics
University of the Punjab, Lahore

Abstract:

Dilute magnetic semiconductors (DMS) are gaining interest at a very fast pace due to the possibility of their integration with the current semiconductor technology. Mn doping into ZnO prepared by sol-gel technique is being investigated by our group. The sol-gel technique used in our case is the standard one in which sols are mixed and spun onto the desired substrate. The flow chart of the whole process is given in Fig. 1. The resultant nanostructures are shown in the scanning electron micrographs of Fig. 2. These materials were also characterized by X-ray diffraction and the variation of grain size & full-width at half maximum are shown in Figs. 3&4. These figures show a decreasing trend in grain size with increase in Mn content and this fact is well correlated with the SEM images as is evident from Table – 1.

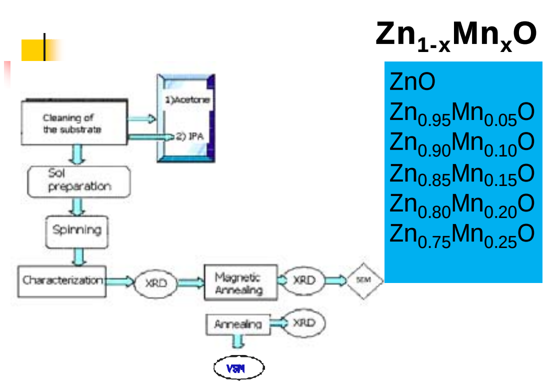


Fig. 1:

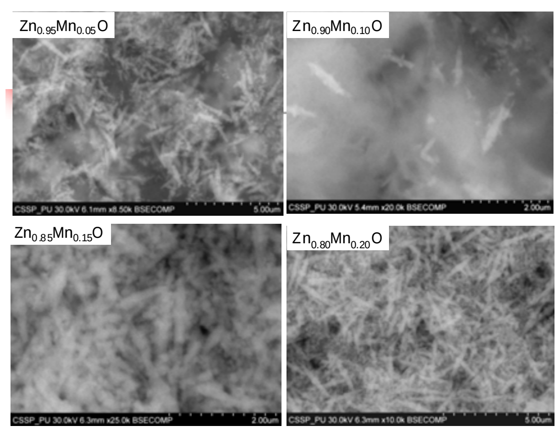


Fig. 2:

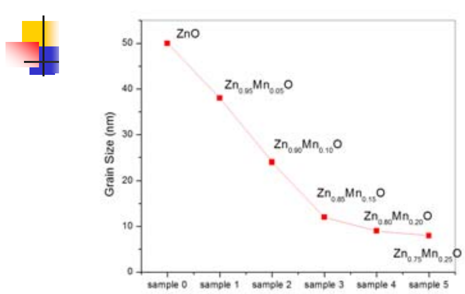


Fig. 3:

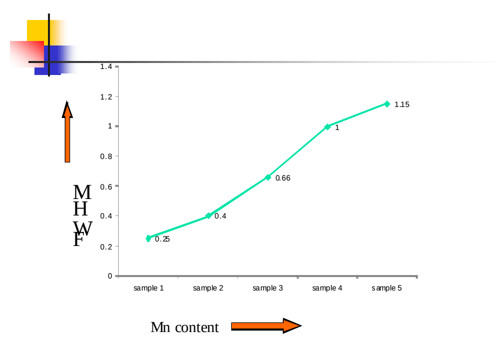


Fig. 4:

Table – 1

Sample	**Variation in Central Zn Nucleus**	**Structure**
ZnO	300 nm	Nano Rods
$ZnO_{0.95}Mn_{0.05}O$	200 nm	Nano Rods
$ZnO_{0.90}Mn_{0.10}O$	150 nm	Nano Rods
$ZnO_{0.85}Mn_{0.15}O$	140 nm	Nano Rods
$ZnO_{0.80}Mn_{0.20}O$	100 nm	Nano Rods
$ZnO_{0.75}Mn_{0.25}O$	25 nm	Nano tweezers

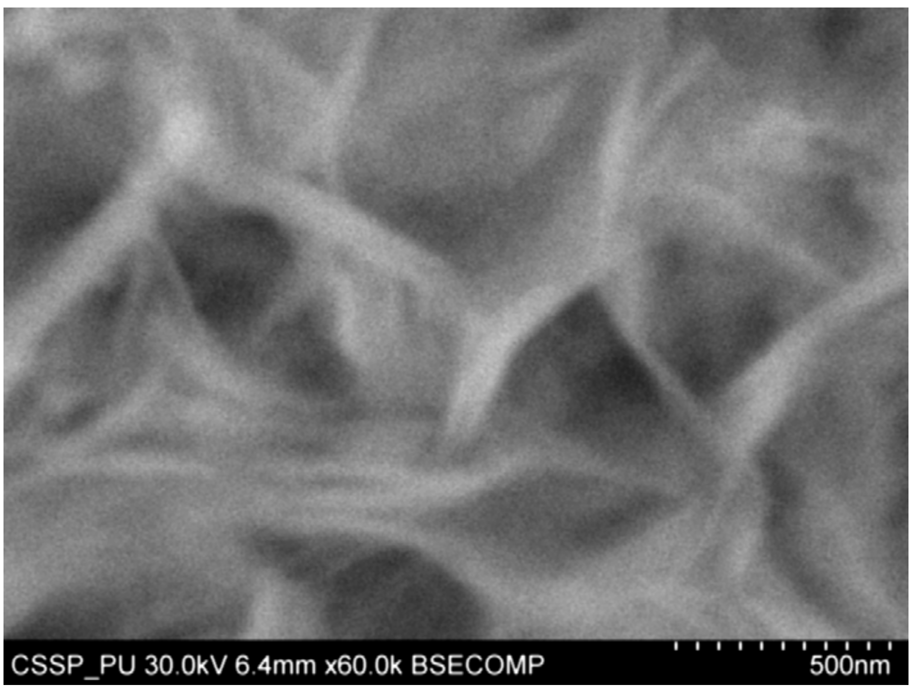


Fig. 5 above shows the evidence of formation of nano-tweezers as mentioned in Table – 1.

Electrodeposition of $L1_0$ Ordered $Co_{1-x}Pt_x$ NanoParticles and nanowires

Rizwana Kausar, Shazia Naeem, Saira Riaz and Shahzad Naseem

Centre of Excellence in Solid State Physics
University of the Punjab, Lahore

Abstract:

In this paper, we report on the preparation of nanowires of CoPt in the AAO templates. These CoPt nanowires were deposited after optimizing the growth conditions at different voltages using the electrodeposition technique [shown in Fig. 1]. $L1_0$ ordered fct structures [as can be seen in Fig. 2] were observed in the as-deposited nano-materials that persisted even after magnetic annealing. The c/a ratio of these structures remained around 0.975 [Fig.3] that is indicative of the formation of such ordered structures. This fact is also supported by taking into account the I_{001}/I_{111} ratio plotted at different applied voltages [Fig. 4].

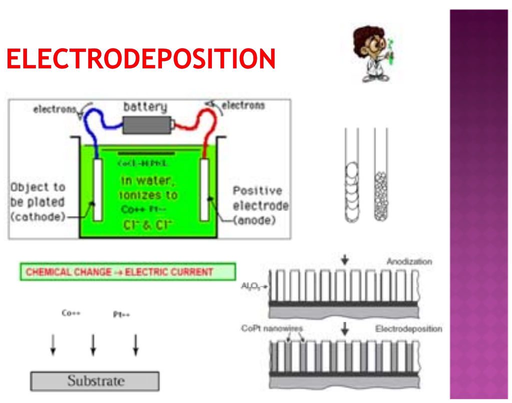


Fig. 1:

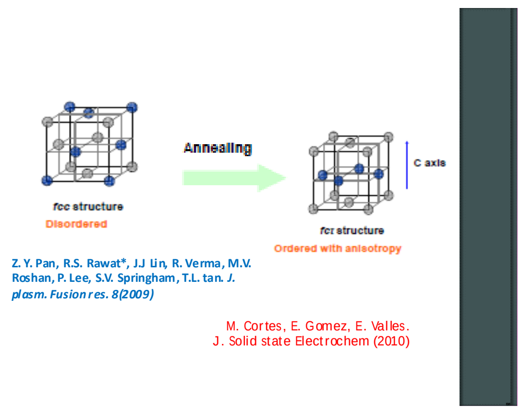


Fig. 2:

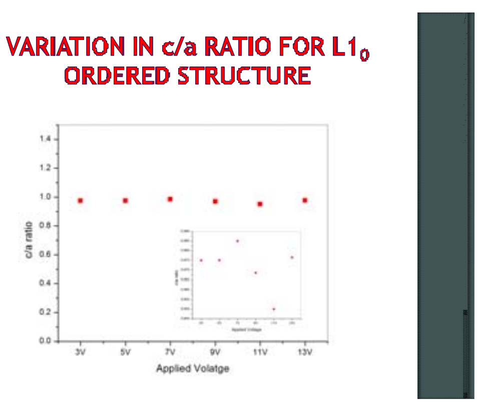


Fig. 3:

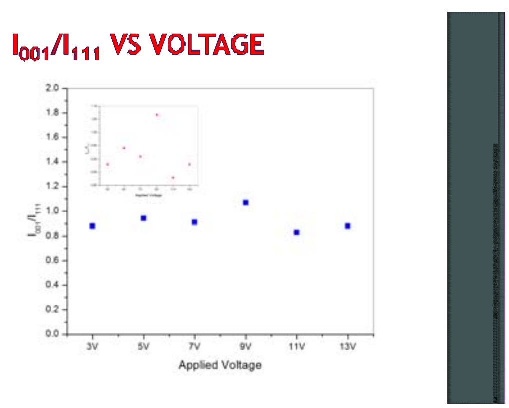


Fig. 4:

Scanning electron micrographs [Figs. 5 & 6] show stacked layers of ordered structure with nano-particles and nanowires.

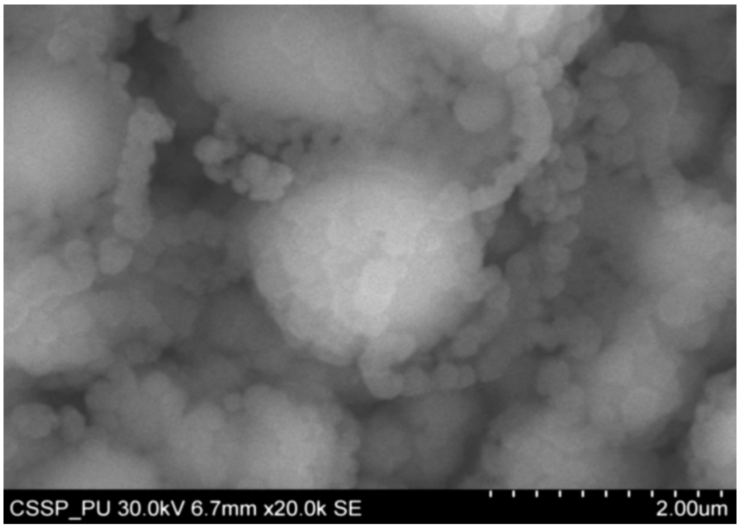


Fig. 5:

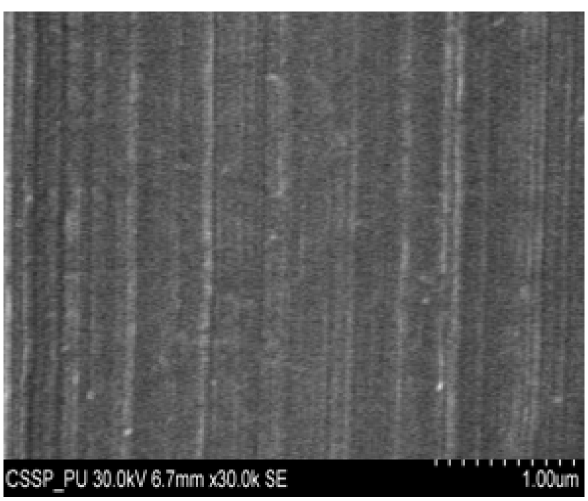


Fig. 6:

Ellipsometry of $Zn_XCd_{1-X}S$ Thin Films

M. Ashfaq Jamil, Saira Riaz and Shahzad Naseem

Centre for Solid State Physics
University of the Punjab, Lahore

ABSTRACT

Thin films of zinc cadmium sulphide – a ternary compound intended to be used in solar cells – are prepared by co-evaporation. The films are prepared at room temperature, in a vacuum better than 10^{-5} Torr. The composition of these films is varied from x = 0.1 - 0.9 with odd x values in the compound $Zn_xCd_{1-x}S$. The optical properties are studied as a function of x. The direct band gap value varies from 2.4eV to 3.2eV. The effect of thermal annealing on optical properties is also studied and is being presented here.

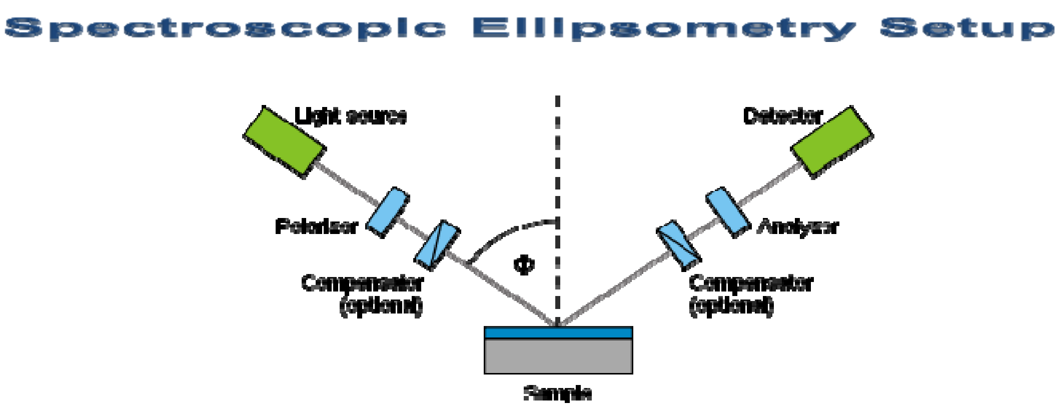


Fig. 1 Schematic setup of an Ellipsometry experiment

Data acquisition

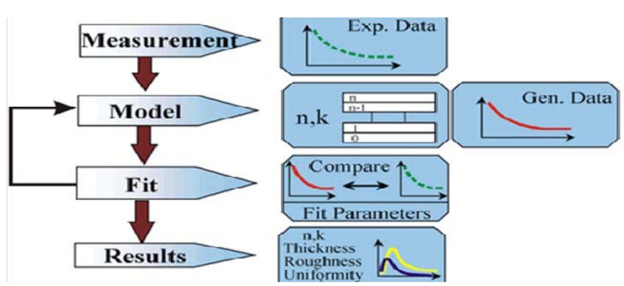


Fig. 2 Flow chart for Ellipsometry data analysis

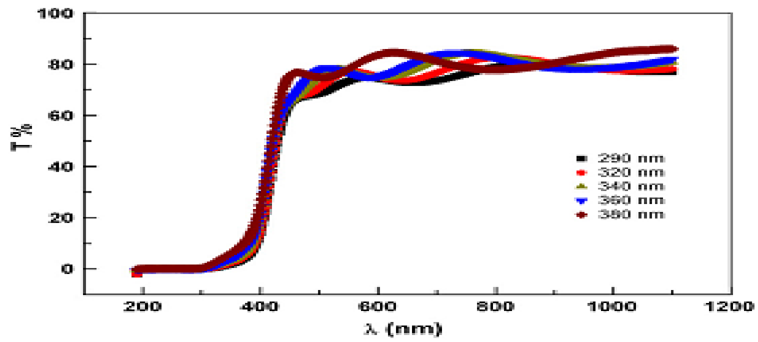


Fig. 10. Optical transmittance of $Zn_{0.5}Cd_{0.5}S$ films at different thicknesses.

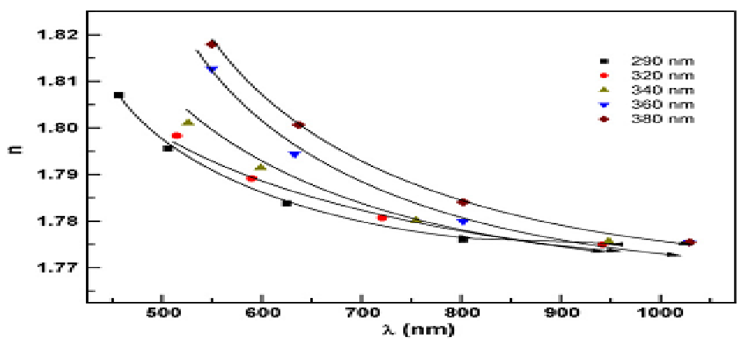
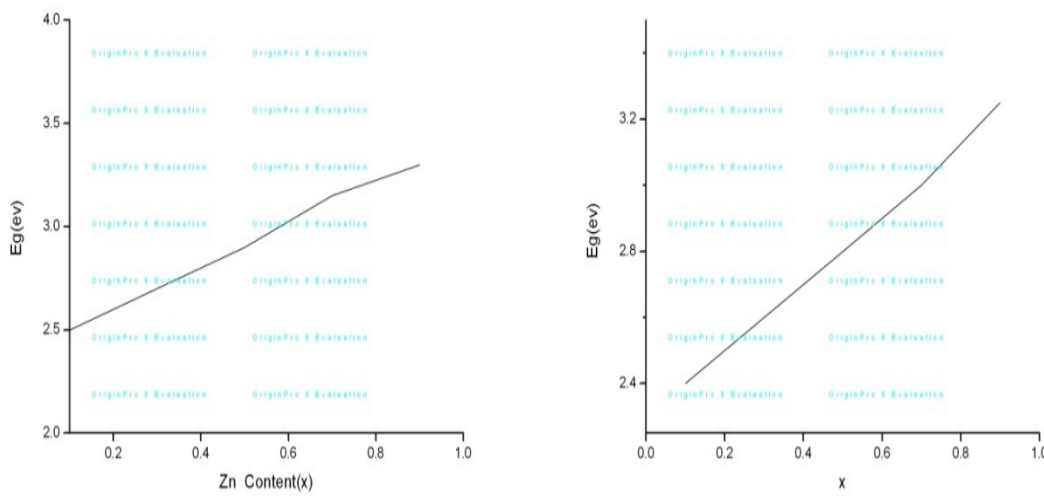


Fig. 11. The dispersion curves of refractive index of $Zn_{0.5}Cd_{0.5}S$.

Comparision of unannealed & annealed samples ($zn_xcd_{1-x}s$):



(a) (b)

Fig. 5 Bandgap variation of $Zn_xCd_{1-x}S$ (a) unannealed (b) annealed thin films with Zn concentration.

Branched carbon nano-tube formation through cracks and AAO template

Muhammad Yasir, Shumaila Islam, Saira Riaz and Shahzad Naseem

Center of Excellence in Solid State Physics
Punjab University, Lahore

ABSTRACT:

In this paper, we report initial results on the formation of branched carbon nano-tubes. These structures have been deposited through 2 different templates, namely: polymer resist and anodic aluminum oxide (AAO) templates. In case of the polymer templates, the resist was deposited onto a single crystal silicon substrate and was given thermal shock by a sudden dip in the liquid nitrogen under the conditions shown in Fig. 1. This produced nano-cracks in the resist material in which carbon was deposited using CVD technique in which methane plasma was generated by applying high voltages, as shown in Fig. 2.

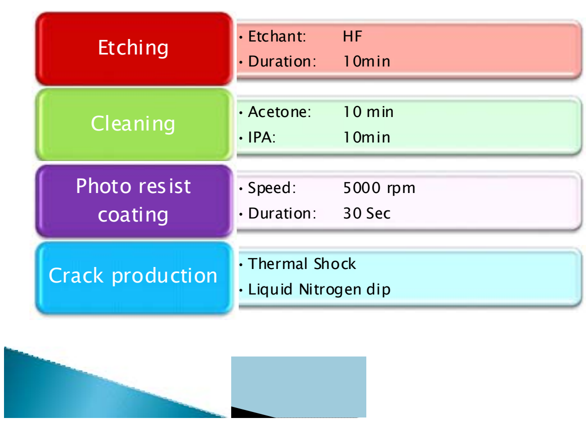


Fig. 1

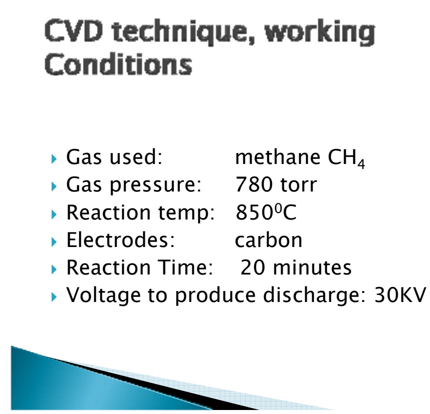


Fig. 2

The resist material was then removed by lift-off technique. The resultant nanotubes are shown in Figs. 3&4 clearing exhibiting branched network of carbon nanotubes.

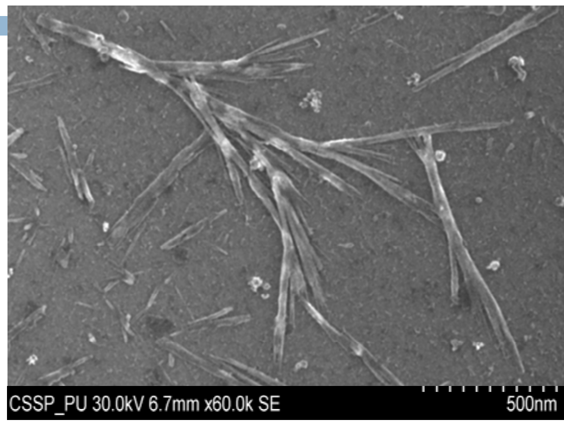


Fig. 3

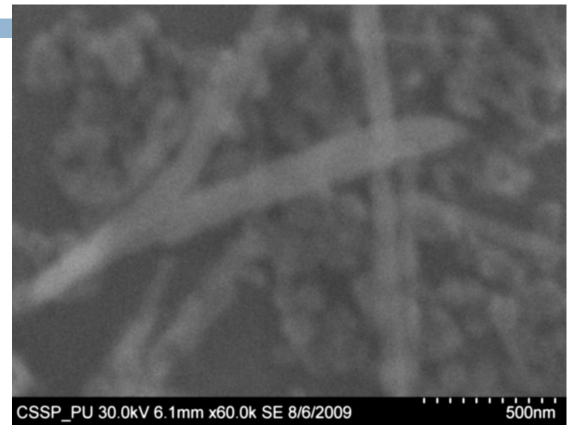


Fig. 4

In case of AAO templates the deposited material's surface can be seen in a representative scanning electron micrograph of Fig. 5 whereas the resulting branched nanotubes can be seen in Fig. 6.

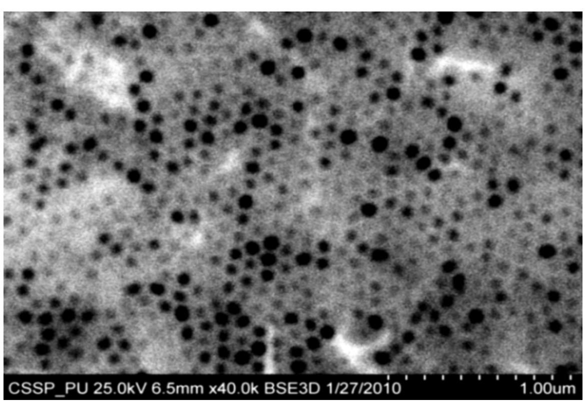


Fig. 5

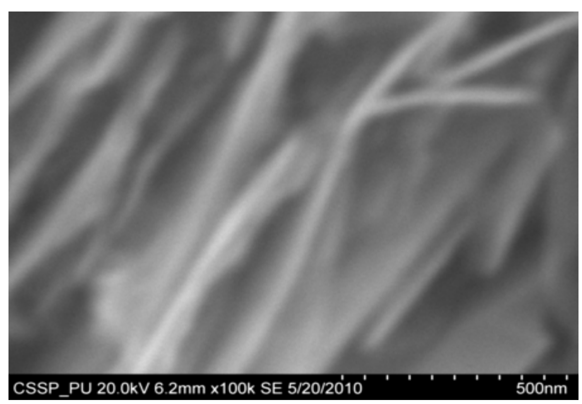


Fig. 6

Synthesis and characterization of ZnO nanoparticles through sol-gel route

Robina Ashraf, Saira Riaz and Shahzad Naseem

Center of Excellence in Solid State Physics
Punjab University, Lahore

ABSTRACT:

In this paper, we report on the synthesis of sols for depositing ZnO nano-particles. The synthesis process is explained in Fig. 1 through a block diagram. The resultant sol was spun onto Si single crystal substrates. The as-deposited and dried thin film showed ZnO peaks through XRD analysis [Fig. 2] and it showed a mixed magnetic behavior of para- and ferro-magnetism whereas the literature reported a diamagnetic ZnO [Fig. 2]. The nano-particles deposited onto Si were then MF annealed at 200oC, and a complete transformation to ferromagnetic behavior was seen [Fig. 3]. It was also observed through SEM that the size of nano-particles reduced from 250 nm to 25nm during this heating process as shown in Fig. 4.

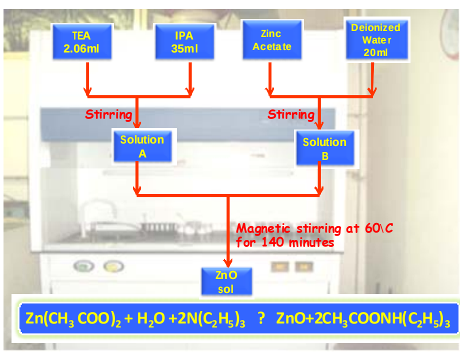


Fig. 1:

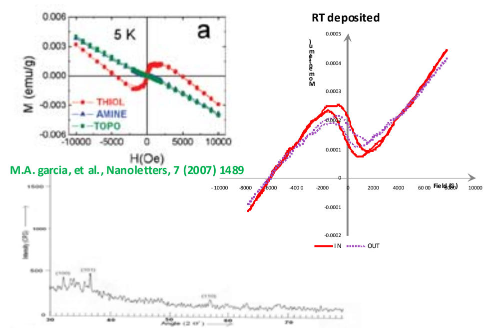


Fig. 2:

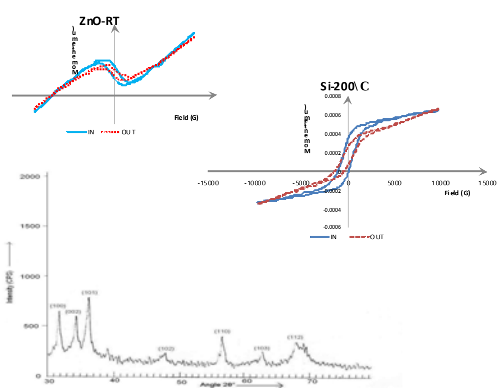


Fig. 3:

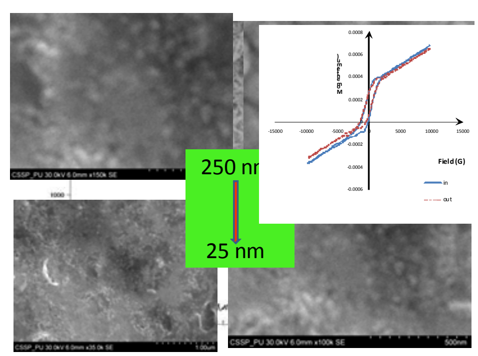


Fig. 4:

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