Pacific Centre for Advanced Materials and Microstructures (PCAMM)

20th Annual Meeting:
Sponsored by Systems for Research Corp and Physics Department at SFU

Date: Saturday, Dec. 12, 2015
Where: Shrum Science Centre, K9500, Simon Fraser University, Burnaby Mountain

9:30 Welcome Coffee and Poster Session

Chair: Simon Watkins or Karen Kavanagh

10:00-10:30am Invited talk: **"Nanofibers for Flexible Electronics, Wearables and Health Monitoring"**, Peyman Servati, Electrical and Computer Engineering, UBC

10:40-10:55pm **"Nano-objects to control magnetic hyperthermia performance"**, Irene Andreu, SFU

11:00-11:15pm **"Zn_3N_2 and ZnGaN alloy thin films growth and characterization by MBE"**, Peng Wu, UVic

11:20-11:50am Invited talk: **"Targeted crystal growth with synergistic magnetic and electronic properties"**, Eundeok Mun, Physics, SFU

12:00-2:00 Lunch and Poster Session

Chair: TBA

2:00-2:30pm Invited talk: **"Extending electron phase imaging and manipulation with vortex beams, phase plates and holography"**, Arthur Blackburn, Research Scientist, STEHM Lab, UVic

2:40-3:10pm Invited talk: **"Towards Next Generation Organic Photovoltaics"**, Loren Kaake, Chemistry, SFU

Posters

1) Nano-objects to control magnetic hyperthermia performance

Irene Andreu, Eva Natividad, Laura SolozÃibal, Olivier Roubeau, SFU

Abstract: Magnetic hyperthermia is a cancer treatment that uses magnetic nanoparticles (MNPs) to selectively increase the temperature of tumours under alternating magnetic fields. One current challenge is achieving therapeutic effects with a minimal amount of MNPs, for which high heating abilities are pursued. It has been recently demonstrated that the same MNPs can generate significantly different amounts of heat, for example, when dispersed in different media, [1] or after cell internalization, [2] indicating that magnetic interactions are of foremost importance in magnetic hyperthermia therapies.
In this work, we first show that the heating ability is reduced over 80% when the MNPs under study can agglomerate freely, as it usually happens in biological systems. We then develop a strategy based on the synthesis of nano-objects able to confine nanoparticles in fix arrangements to reduce the detrimental effects of uncontrolled agglomeration. [3] We synthesized MNP-loaded polymeric nanospheres and silica nanoworms to confine the MNPs in distinct arrangements, respectively. Their different magnetic response can be explained through the morphologies of the obtained arrangements. The heating ability of closely-packed nano-objects remained high, contrarily to freely-arranged MNPs after agglomeration. This suggests that similar nano-objects could be used to obtain high and reproducible heating powers in magnetic hyperthermia applications.

References: [1] I. Andreu et al. (2015) J Magn Magn Mater (380) 341-346; [2] Di Corato et al. (2014) Biomaterials (35) 6400-6411; [3] I. Andreu et al. (2015) ACS Nano (9) 2, 1408-1419

2) Effect of microstructure on the magnetic properties of Co/Ni multilayer films for use in STT-MRAM

M. Arora, N. R. Lee-Hone, T. Mckinnon, E. Montoya, B. Heinrich, D.M. Broun, E. Girt, SFU

Abstract: Untill recently, most research was focused on in-plane spintronic devices in which magnetization of both the fixed and the free layer lie parallel to the film surface. For a given thermal stability, perpendicular spintronic devices, in which the magnetization is perpendicular to the magnetic films require smaller critical current densities for the reversal in magnetic layers than in-plane devices. Magnetic properties of (111)-textured SAF/Cu/FL multilayer film structures were optimized by varying individual layer thickness and sputtering conditions. The SAF is a synthetic antiferromagnet (SAF) consisting of Co/Ni multilayers coupled antiferromagnetically across a Ru spacer layer, and FL is a free layer consisting of a single Co/Ni multilayer. A single layer of [Co/Ni]x8 was grown on different thickness of Cu layer. The magnetization measurements has been done using SQUID at room temperature. It is

observed that the thickness of the seed layer does not affect the average perpendicular magnetic anisotropy, however, has a large impact on the distribution of magnetic anisotropies in Co/Ni films. High resolution crossectional Transmission electron microscopy (TEM) has been used to find the change in grain size and growth of the multilayers. The results shows that roughness increases with the increase in thickness of the Copper as a seed layer.

3) Synthesis of copper antimony sulfide nanoparticles hot injection method: monitoring nucleation and growth

Faibio Baum,[1,3] Alexandre G. Brolo,[3] Marcos Josa Leite Santos,[1,2]

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[2]Instituto de Química da Universidade Federal do Rio Grande do Sul, Brazil
[3]Department of Chemistry, University of Victoria, Canada.

Abstract: In this work, we aim to evaluate the mechanisms governing the nucleation and growth of cadmium and lead-free ternary quantum dots of copper antimony sulfide. The CAS were synthesized by the hot injection method, using copper chloride (I) and antimony chloride (III) as metal precursors, sulfur and oleylamine as solvent and capping ligand. The synthesis were performed in a temperature range between 200 Â°C and 260 Â°C, and reaction were allowed for 1, 2, 5 and 10 minutes. The obtained nanoparticles were characterized by UV-NIR absorption spectroscopy, transmission electron microscopy (TEM) and X-ray diffraction (XRD). The TEM images of the nanoparticles synthesized during 5 minutes at 200 Â°C shows a mixture of nanoplates and nanorods. XRD data revealed that in the first minute of reaction, Cu11.4Sb4S12.77 was formed, followed by Cu3SbS4 after 5 minutes and finally CuSbS2 after 10 minutes of reaction. Additionally, according to TEM images except for the particles synthesized at 230 Â°C, the size of the particles decreases along with the reaction time. This result is probably related to change in stoichiometry and reorganization of the unit-cells as the reaction progresses. The changes in stoichiometry usually evolve from antimony-poor compounds such as Cu3SbS4 or Cu12Sb4S13 obtained after short reaction periods to the copper-antimony equivalent compounds after long reaction periods. The results suggest that the antimony precursor presents higher activation energy than the copper, hence the kinetics for antimony inclusion in the particle is slower than for copper. UV-VIS-NIR absorption spectra show that antimony poor nanoparticles such as Cu12Sb4S13 and Cu3SbS4 present a broad absorption mode within the NIR region. On the other hand, CuSbS2 nanoparticles present a broader absorption range, which is closer to the visible region.

4) Shape-Controlled Synthesis of CdSe Quantum Dots via Ionic Liquid Assisted Hot- Injection

Faibio Baum,[1,3] Graciane Marin,[2] Virga-nia Serra de Souza,[2] Alexandre G. Brolo,[3] Jairton Dupont,[4] Marcos Josa Leite Santos[1,2]

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Abstract: Cadmium selenide (CdSe) quantum dots were synthesized via ionic liquid assisted hot-injection method. In this approach, the typical non-coordinating solvent, octadecene, was fully replaced by four different ionic liquids: 1-methyl-3-butylimidazolium tetrafluoroborate (BMI.BF4), 1-methyl-3-butylimidazolium bis(trifluoromethanesulfonyl)imide (BMI.NTf2), 1-methyl-3-octylimidazolium bis(trifluoromethanesulfonyl)imide (OMI.NTf2) and 1-methyl-3-decylimidazolium bis(trifluoromethanesulfonyl)imide (DMI.NTf2). In a three-neck flask, cadmium acetate dihydrate, oleic acid and the ionic liquid were heated up to 240 Â°C, under Argon atmosphere. In another flask, trioctylphosphine and selenium powder were heated up to 60 Â°C and stirred until a clear solution was observed. The selenium solution was injected into the cadmium acetate solution; the reaction was performed for 2 minutes, followed by rapid cooling down to around 10 ÂºC. The obtained quantum dots were characterized by UV-VIS absorption spectroscopy, photoluminescence spectroscopy (PL), transmission electron microscopy (TEM) and X-ray diffraction (XRD). According to UV-Vis and PL spectra, the quantum dots present similar optical behavior than quantum dots synthesized in octadecene. However, TEM images show the growth of elongated worm-like particles. By comparing the particles obtained in the set of ionic liquids with different alky groups in the imidazolium cations, the particles synthesized in BMI.BF4, BMI.NTf2 and OMI.NTf2, present nearly the same length, however when in DMI.NTf2, much longer particles are synthesized. These results suggest that the substituting group in the imidazolium has a critical role on nucleation and growth of the Quantum Dots. This can be an important feature in tailoring the shape of nanoparticles, allowing the synthesis of anchoring shaped structures which enhanced ability to sensitize porous structures.

5) $CaCl_2$ - Silica Gel Composite for Adsorption Cooling Systems

Michelle Cheung, Claire McCague, Majid Bahrami, SFU

Abstract: The vapor compression systems commonly used for air conditioning and refrigeration consume significant amounts of electrical power and employ environmentally harmful refrigerants. The power used by HVAC systems to provide

thermal comfort in residential and commercial buildings, amounts to 10-20% of the total energy consumed in the developed world. Efficient,sustainable cooling technologies are presently the focus of significant research and development efforts. Heat-driven adsorption cooling systems are an emerging and sustainable technology in which an environmentally friendly refrigerant, such as water, is adsorbed by a porous sorbent material. Adsorption cooling systems can be designed to produce cooling power by utilizing waste heat or solar thermal energy. Current challenges that face the development of efficient adsorption cooling systems include low heat and mass transfer rates through the adsorber bed. Novel composite adsorbents with tailored properties are required to improve the overall performance of adsorption cooling systems. Researchers from the LAEC have studied composites containing hygroscopic salt (CaCl2), mesoporous silica gels, binder (polyvinylpyrrolidone, PVP), and thermally conductive additives (graphic flakes). In this study, CaCl2 confined in silica gel (0.25-0.5 mm grains, average pore diameter 15 nm) is consolidated with graphite flasks and organic binder polyvinylpyrrolidone (PVP40, 40 000 MW). The sorbent composites were prepared in different mass ratios of CaCl2 to silica gel (1:1, 1.5:1, and 2:1) with 25%wt graphite flakes and 15%wt PVP. From the adsorption isotherm,increasing the salt content improved water uptake capacity but negatively impact the water uptake rate. Based on the porosimetry results, CaCl2 filled in the pores of mesoporous silica gel. Transient plane source "hot disk" thermal conductivity tests in an environmental chamber found that composites tested at 20% relative humidity at 35C had greater thermal conductivities than composites tested under dry conditions (0% relative humidity) at 35C. Short duration multi-cycle performance studies of the composite were performed under adsorption cooling cycle conditions using a thermogravimetric vapour sorption analyzer.

6) Design Considerations of Biaxially Tensile-Strained Germanium-on-Silicon Lasers

Xiyue Li[a, b], Zhiqiang Li[c], Simon Li[c], Lukas Chrostowski[d], and Guangrui (Maggie) Xia[b]

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Abstract: Physical models of Ge energy band structure and material loss were implemented in LASTIP™, a 2D simulation tool for edge emitting laser diodes. The model calculation is able to match experimental data available. Important design parameters of a Fabry-Perot Ge laser, such as the cavity length, thickness, width, polycrystalline Si cladding layer thickness were studied and optimized. The laser structure optimizations were shown to reduce the threshold current by 22-fold. The simulations also showed that improving the defect limited carrier lifetime is critical for

achieving an efficient and low-threshold Ge laser. With the optimized structure design (300 mm for the cavity length, 0.4 mm for the cavity width, 0.3 mm for the cavity thickness, and 0.6 mm for the polycrystalline Si cladding layer thickness) and a defect limited carrier lifetime of 100 ns, a wall-plug efficiency of 14.6% at 1mW output is predicted, where J_{th} of 2.8 kA/cm^2, I_{th} of 3.3 mA, I_{1mA} of 9 mA, and h_d of 23.6% can also be achieved. These are tremendous improvements from the available experimental values at 280 kA/cm^2, 756 mA, 837 mA and 1.9%, respectively.

7) Electron beam induced current measurement of Carrier Diffusion Lengths in GaAs and GaAs\InGaP Nanowires

K. L. Kavanagh, S. P. Watkins, SFU

Abstract: Development of nanowire-based semiconductor devices including solar cells, lasers and light emitting diodes is limited by challenges that need further investigation. This includes the effect and control of the NW sidewall surface states. Due to the large surface-to-volume ratio in NWs the surface states play a major role in limiting the electronic properties of NW devices. Minority carrier diffusion length (Ld) in semiconductor NWs are directly impacted since the surface states act as recombination sites.

Here we present the study of electron and hole diffusion lengths in p-type and n-type GaAs NWs using the electron beam induced current (EBIC) method. EBIC measurements were carried out on free standing NWs using a nanoprobe technique implemented inside a scanning electron microscope, without the need for lithographic processing. NWs were grown by the vapor-liquid-solid method using metalorganic precursors at at a growth temperature of 400Â°C, and using diethyltellurium and diethylzinc as the n- and p-type dopants.

Two types of structures were fabricated: (1) single carrier type structures where the depletion region under the Au catalyst particle was used to collect minority carriers, and (2) n-p axial homojunction structures where the EBIC signal was measured separately on either side of the junction.

The effect of carrier concentration on the diffusion lengths as well as the diameter dependence of Ld were studied. It was observed that for both types of minority carriers Ld reaches a maximum of less than 200 nm for NWs with radius up to 400 nm. The obtained results are lower than the reported Ld for GaAs thin films with values larger than 1 Âµm. In order to further enhance the diffusion of minority carriers, a 15 nm thin lattice-matched InGaP shell passivated the GaAs core NW. EBIC results indicated a 2 fold enhancement of Ld in p-type GaAs, and an order of magnitude decrease in the surface recombination velocity.

8) Lithography-free fabrication and electrical analysis of GaAs core-shell tunnel diodes

A. Darbandi, D.J. Dvorak, K.L. Kavanagh, S.P. Watkins, SFU

Abstract: Core-shell tunnel diodes have potential applications in highly scaled transistor devices as well as in photovoltaic applications as interconnects between multiple core-shell p-n junctions. We have developed a method for fabricating core-shell tunnel diodes without lithography using a novel hybrid technique which combines metal-organic vapour phase epitaxy (MOVPE) and atomic layer deposition (ALD). Short Au-catalysed GaAs â€˜pedestalsâ€™ are coated in a thin, conformal film of Ga2O3 which is generally stable at the growth temperature of 400Â°C, but will selectively weaken around the gold particle at the tip of the nanowire pedestals. This allows for continued nanowire growth in which subsequent axial and radial nanowire segments are electrically isolated from the substrate. Electrical characterization is performed using a tungsten nanoprobe inside a scanning electron microscope (SEM) using the Au nanoparticle as an Ohmic p-contact. Radial tunnelling was observed with a maximum peak-valley current ratio of 3.1 and a maximum peak current density of 2.1 kA/cm2.

9) Spectral Photovoltaic Response of MBE grown GaAs and GaAsBi containing p+/n Solar Cells

M. Masnadi-Shirazi, Zenan Jiang, R. B. Lewis, V. Bahrami-Yekta, P. Servati, and T. Tiedje, UVic

Alloying III-V semiconductors with Bismuth (Bi) has attracted interest as a way to make long wavelength semiconductor devices. Incorporation of Bi in GaAs causes a large reduction of the bandgap (~83 meV/% Bi), allowing 1 eV bandgap and beyond to be reached on GaAs with less strain than for In, Sb and N. This property along with the fact that GaAs1-xBix shows strong photoluminescence indicates that this material can be used to extend the response of GaAs to longer wavelengths for applications in optical devices such as multi-junction solar cells.

In this study, the photovoltaic response of GaAs and GaAs1âˆ’xBix (0<x<1.1%) containing p+/n diodes were investigated under one sun illumination to examine the effect of Bi alloying. The typical layer structure of the bismide solar cell that was grown by molecular beam epitaxy (MBE) is illustrated in Fig. 1. The films were p-doped to ~3Ã—1018 cm-3 with carbon from a CBr4 source and n-doped to ~1017 cm-3 with Si. Similar device structures were fabricated with GaAs films grown under conventional conditions (580Â°C substrate temperature, As:Ga flux ratio of 6) and under the conditions used to grow the Bi alloys (330Â°C substrate temperature, As:Ga flux ratio of 2). The standard grown GaAs cell shows better photovoltaic performance than the GaAs cell grown at low temperature due to the fewer defects incorporated at high growth temperatures. The spectral responses of GaAsBi devices were measured and the photovoltaic response was observed to extend up to ~1000 nm wavelength with 1.1% Bi concentration. The experimental results were fitted with a theoretical model in order to

determine the effect of Bi on minority carrier lifetime in n and p-type Bi alloys. The electron and hole minority carrier lifetimes were found to be in these ranges, with up to 1.1% Bi concentrations: 10-13<Ï„e<5Ã—10-13 sec and 5Ã—10-12<Ï„h<10-10 sec respectively. The lifetimes showed only a weak dependence on Bi concentration and were found to be lower than the minority carrier lifetimes in standard grown GaAs (3Ã—10-11<Ï„e<10-10 sec and 10-9<Ï„h<10-7 sec).

10) Investigations in Hydrodynamics for Piezoelectric Cell Printing by using Microscopy Imaging Techniques

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Abstract: Inkjet cell printing has received considerable interests due to its capability to engineer tissues and organs [1, 2, 3]. Instead of growth of single layers of cells in cell culture, cell printing has the advantage to construct multiple different types of cells positioned in intricate three-dimensional orientations. Cell printing also promises to have large impact in the development of cell-based assays. However, the wide commercialization of this technology is limited by the lack of comprehensive understanding underlying the physical and biological phenomenon within an inkjet printer. Such that the printing system has not been well controlled to achieve high reliability.

In order to meet the challenge, this work investigates the physical and hydrodynamic processes within a piezoelectric inkjet printer with the assistances of microscopy imaging techniques. A typical inkjet cell printing setup is schematically shown in Fig. 1. The piezoelectric inkjet system converts electrical signals to mechanical pulses, resulting in jet dispensing. Within a nozzle (Fig. 2a), the high speed camera visualizes the trajectory of a cell (Fig. 2b), as well as the jet ejection from the orifice (Fig. 2c). The visualized images enable us to investigate the physical processes concerning droplet formation, jet dispensing, thread thinning and breakup. Furthermore, micro-particle image velocimetry can allow us to reconstruct the velocity field evolution (Fig. 2d) during droplet ejection within a nozzle. Through the above studies, we found that the fluid density influences the cell sedimentation. Our results also indicate that fluid viscosity plays an important role in influencing the cell behavior during the droplet dispense process.

References: [1] B. Derby (2012). Science 338, 921-926; [2] B. Lorber, et al. (2014). Biofabrication 6, 015001-015009; [3] D. Chahal, et al. (2012). Biotechnol. Bioeng. 209, 2932-2940.

11) Water permeation through a model anion exchange membrane: the importance of membrane interface

Xiaoyan Luo, Thomas Weissbach, Andrew Wright, Benjamin Britton, and Steven Holdcroft, SFU

Abstract: An understanding of water permeation through ion exchange membranes is crucial to offset the unbalanced water transport within ion exchange membrane fuel cells. Using ex-situ water permeation experiment, we have examined water permeation through an anion exchange membrane â€' HMT-PMBI, and compare with proton exchange membraneâ€' Nafion. The bulk (internal) permeation resistance of HMT-PMBI membrane takes small portion in the overall membrane permeation resistance. However, interfacial permeation resistance is found to play a crucial role in determine the overall water permeation. The ratio of interfacial permeation resistance to the overall resistance is smaller in HMT-PMBI membrane as compared to Nafion for a normalized membrane thickness. The degree of methylation has a strong impact on water permeation resistance of HMT-PMBI. The changes in the interfacial water permeation resistance is correlated with the changes in the degree of methylation in the membranes. Catalyst layer is found to have no influence on the internal and interfacial permeation resistance regardless of membrane thickness.

12) Electrochemically Defined Defects in Au-Thiol Self Assembled Monolayers

Isaac Martens, Elizabeth Fischer, Kamil Krawczyk, Dan Bizzotto, UBC

Abstract: We show how a combination of electron and atomic force microscopy can be used to image the microstructure of gold-thiol monolayers in a cheap, easy, and fast manner. After electrochemically producing defects in the monolayer, thiolated DNA can be incorporated and similarly imaged. This approach allows direct monitoring of a surface functionalization commonly used to produce biosensors.

13) Optical Trapping and Diagnostic Analysis of ~20nm Gold Nanoparticles Using Photonic Crystal Slot Microcavity

S. Hamed Mirsadeghi, Jonathan Massey-Allard, Jeff F. Young, UBC

Abstract: We report our recent advances in using silicon-on-insulator (SOI) photonic integrated circuits for trapping sub-60nm gold spheres and rods with sub-mW laser powers. Experimentally obtained transmission time-series histograms can be analyzed to model the dynamics of the trapped nanoparticles. Quantitative analysis of the histograms is shown to be very sensitive to the shape and anisotropy of the trapped particles and can be used to accurately determine their size.

14) Spin Transport Study of Pd and Ta by Means of Spin Pumping

Eric Montoya, Pavlo Omelchenko, Chris Coutts, Bret Heinrich, Erol Girt, SFU

In spin fluctuating metals with strong spin correlation effects such as Pd, thermally excited fluctuations of local spin moment known as paramagnons lead to dephasing of spin currents on much shorter length scales then in normal metals. In Pd the spin pumping contribution to the Gilbert damping saturates at a thickness shorter than the mean free path. In contract, damping saturates even faster in Ta, but due to the high resistivity, the mean free path is much shorter as well. The two systems present an interesting limit in which to explore spin transport models.

15) Nanoparticle Decorated Porous Catalysts

Paul, Michael T.Y; Zhang, Xin; Yee, Brenden; Pilapil, Brandy K.; Gates, Byron D, SFU

Abstract: The incorporation of catalytic nanoparticles (NPs) within nanostructured materials have been popular in recent years due to the excellent surface area to volume ratios and their ability to reduce the required loading of precious metal catalysts. The use of Pt and Pd NPs are especially attractive for power generating systems, such as proton exchange membrane and alcohol oxidation fuel cells. Further studies on these nanoparticle incorporated materials have revealed the underlying support materials can enhance catalytic properties and stabilities of the NPs. However, due to processing constrains, loading of functional NPs is often limited to 2-D supports. In this study, we demonstrate a relatively simple and cost effective method for preparing various combinations of NPs loaded into 3-D structured materials. The NP loading and spatial distribution were characterized by scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy dispersive X-ray spectroscopy (EDS). Our technique could be used to prepare novel electrochemical and photochemical porous materials for increased catalytic efficiency and stability.

16) Characterization of PLD grown ZnTe thin films with different growth temperatures

John Preston, SFU

Abstract: Compound semiconductors are the foundation of many electronic and optoelectronic devices. As a result semiconductor epitaxy can be viewed as the first significant step in device engineering. Accurate and reliable characterization methods are needed to measure semiconductor properties including optical, electrical, vibrational and crystal structure. In this poster, the epitaxy of ZnTe thin films on sapphire substrate by Pulsed Laser Deposition system at different growth temperatures is presented. The texture analysis is inspected by Two Dimensional X-Ray Diffraction. The lattice constant of the films and strain studies are investigated by High Resolution X-Ray Diffraction.

UV-Vis spectroscopy is applied to find absorption edge in ZnTe thin film in order to estimate optical bandgap. These common characterization methods reveal the great effect of growth temperature on crystalline and optical properties of ZnTe thin films. In addition, Raman spectroscopy is used for the first time in the Preston's group to examine vibrational modes in ZnTe thin films.

17) Zn_3N_2 and ZnGaN alloy thin films growth and characterization by MBE

Tom Tiedje, Helaleh Alimhammadi, UVic

Abstract: Single crystal Zn3N2 and alloy ZnGaN have been grown on MgO substrates. The films were probed during growth using in-situ techniques. Reflection high energy electron diffraction (RHEED) is used to provide real time information about the crystal structure of the film surface. Light scattering can give information about surface roughness and film thickness. This will primarily involve further measurements using the three key characterization methods, X-ray diffraction, transmittance and photoluminescence, for the structural and optical properties respectively. The crystal structures of film were analyzed post-growth by high-resolution x-ray diffraction (XRD) with the 0.154056nm wavelength. (400)-oriented Zn3N2 and ZnGaN alloy thin films were grown on (200) MgO substrates. Photoluminescence (PL) involves shining light onto a sample to induce optical transition and the resulting emission is then collected and analyzed. The van de pauw method was involved for temperature dependence of sheet resistivity, hall coefficient and majority carrier mobility.

18) Thermal Sublimation: a Scalable and Controllable Thinning Method for the Fabrication of Few-Layer Black Phosphorus

Weijun Luo[1], Rui Yang[2], Jialun Liu[3], Wenjuan Zhu[3], Guangrui (Maggie) Xia[1]

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[3]Department of Electrical and Computer Engineering, the University of Illinois at Urbana-Champaign, Champaign IL, USA

Abstract: We report the layer-by-layer sublimation of BP flakes (about 90 nm thick originally) in the temperature range from 510 to 610 K in nitrogen ambient. Optical microscope, in-situ Raman spectroscopy and atomic force microscopy (AFM) were used to characterize the color and morphology change, the Raman spectra and the thickness reduction of the BP flakes. By these experiments, we established the correlation relations between the BP color, thickness and the Raman intensity ratio of the BP A_g^2 peak to the peak of the underlying Si. With the sublimation thinning method, few-layer BP was successfully thinned down to 4 nm.

19) Epitaxial Fe on Free-standing GaAs Nanowires

Ali Darbandi, Simon Watkins, and Karen Kavanagh, SFU

Epitaxial Fe contacts have been fabricated onto the top half of free-standing, Te-doped GaAs nanowires (NWs) via electrodeposition. Electrical isolation from the substrate via a polymeric layer enabled the measurement of electrical transport through individual wires. Using axed probe within a scanning electron microscope, an average metal-semiconductor diode barrier height of 0.71 Â± 0.02 eV (ideality factor 1.48 Â± 0.02) was found by comparing the experimental data to the simulations based on ideal thermionic emission, consistent with parallel current transport that included the Au catalyst contact.

20) Study of Si-Ge Interdiffusion with High Phosphorus Doping

Feiyang Cai[1], Dalaver Anjum[2], Yiheng Lin[1], Guangrui (Maggie) Xia[1]

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Abstract: Ge/Si0.25Ge0.75/Ge multilayered structures with no P doping and high P doping (about 1e19 cm-3) were investigated. With high P doping, Si-Ge interdiffusion is enhanced by 3 to 5 times, which is due to the Fermi-level effect. By fitting to the experiment data with different annealing temperatures, we found out that the Fermi-enhancement factor of Si-Ge interdiffusion was proportional to n 2 /n i2. This suggests that for the Ge fractions from 0.75 to 1 under high n-type doping, Si-Ge interdiffusion is dominated by V2- point defects. The dependences of the Fermi-level effect on the n-type doping level, the Ge fraction and the annealing temperature were predicted. This is the first work that we are aware of on the quantitative modeling of Si-Ge interdiffusion with high n-type doping.

21) Raman Spectroscopy of Single Nanoparticles

Steven Jones, Ahmed A. Al Balushi, Reuven Gordon, UVic

Abstract: A self-induced back action (SIBA) aperture based optical trapping setup was used to localize a 20 nm dielectric particle. In addition to providing the confinement force, the trapping laser was also used as the excitation source to measure the Raman spectra of the trapped nanoparticles. The observation of Stokes line for individual nanoparticles was made possible via surface enhanced Raman spectroscopy (SERS) due to the significant local field enhancement created by the trapping aperture.