出國報告（出國類別：國際會議）

參加暨發表第 11 屆亞太電漿科技研討會與第 25 屆電漿科學材料研討會心得報告

服務機關：國立雲林科技大學
姓名職稱：黃建盛
派赴國家：日本京都
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摘要

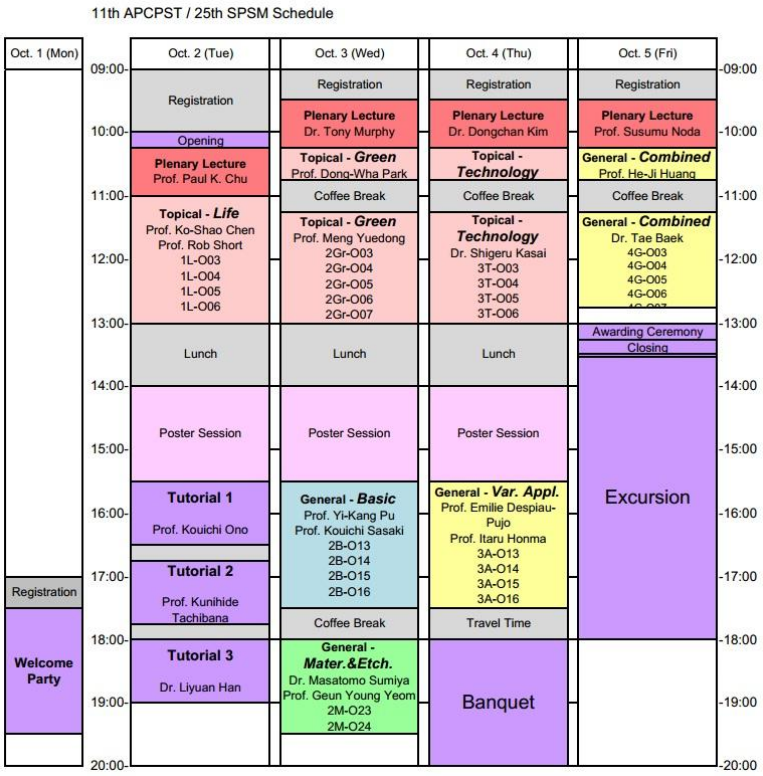
2012 年 10 月 02-05 日在日本京都舉辦亞太電漿科學和技術暨第 25 屆電漿材料研討會。京都，日本歷史最悠久的城市之一，為第 11 屆亞太會議地點。京都大學是這次的會議地點，科學的發展做出了貢獻超過 100 年，是日本最負盛名的大學之一。今年的會議上，委員會花了大量的時間考慮會議的概念。因此，它決定不僅學術討論等離子體科學和技術，但也從行業和企業的角度進行討論。11 日的 APCPST 和 25 日 SPSM 包括來自亞太及其他地區的 18 個國家的 413 報告者，包括 21 個特邀報告。該計劃包括“生活創新”和“綠色創新”的領域集中在“專題會議”，“技術報告會”和“基本電漿的原理和產生”，“材料合成與電漿的蝕刻”，“電漿的各種應用”。藉由參與此會議可以多加接觸各國學者並與之交流，藉著聽取別人的經驗希望可以促進台灣半導體產業更走入國際市場。對於參加 APCPST 和 SPSM 國際會議對於我本人幫助良多，能有更多的機會與國際知名學者交流，聽取前輩們的經驗與建議以使自己的知識與研究都能更進步，並期許未來自己能在台灣這塊土地上對於半導體發展有所貢獻。回顧此次出訪日本，雖然行程緊湊，報告、參訪與討論工作繁重，但所達成的目標與成果非常豐碩，對於提升本校國際知名度與國際級研究成果都將有莫大助益。

目次

一、 目的

2012 亞太電漿科學和技術暨第 25 屆電漿材料研討會，簡稱 APCPST 和 SPSM，此會議為每一年舉辦一次之重要國際會議。包括來自亞太及其他地區的 18 個國家的 413 報告者，包括 21 個特邀報告。世界各國研究新興電漿技術和電子元件以及在環境能源領域應用上之頂尖學者將齊聚一堂，進行交流及討論。隨著光電半導體產業逐漸擴展到世界各地，台灣的生產無論在品質及數量上都極具優勢，藉由參與此會議可以多加接觸各國學者及光電半導體業者並與之交流，藉著聽取別人的經驗希望可以促進台灣半導體科技產業更走入國際市場，另外本人也藉由這次學術發表的機會，尋求國際學校之間的合作與發展之機會，進一步將學術研發結果應用到科技產業上。

二、 過程



- 上圖為研討會日程表

● 9/30（日）第一天前往台灣桃園國際機場—大阪關西國際機場—京都。抵達大阪關西國際機場後搭乘新幹線到達京都市，於傍晚順利入住位於京都 SUPER HOTEL 旅館，準備明日報到與路程規劃相關資料。

● 10/01（一）辦理登記報到，拿了大會資料及註冊的收據，參考手冊的摘要目錄後，尋找其他專家學者交流心得，在註冊時遇到了許多著名的研究人員，與他們互相探討幾個重要的意見後，並回飯店準備 Poster 之相關資料。

● 10/02（二）參加 11th Asia-Pacific Conference on Plasma Science and Technology & 25th Symposium on Plasma Science for Materials (11th APCPST and 25th SPSM) 國際會議開幕典禮，APCPST & SPSM 今年在日本京都的京都大學舉行，共有來自 18 個國家，413 位研究人員參加報告，會議共分成 7 個 subjects，分別是 Life, Green, Basic, Mater.&Etch., Technology, Var. Appl., Combined.

● 上圖為京都大學紀念館門口

總計有來自台灣、韓國、法國、澳洲、及中國等國家的優秀學者應邀發表專題演講，內容集中在先進的電漿技術、生活創新、綠色創新等主題作詳細演講。

上午各國學者進行發表演說與問答，內容聚焦在 Plasma 上並應用於各種領域，材料聚合物、生命科學、醫學、磁性、薄膜等等先進應用。

研討會下午為各國學者將研究結果以海報的形式張貼於會場，並與發表者互相討論學習與研究，全場討論氣氛熱烈。

來自香港大學的 Paul K. Chu 也跟我們分享了 Surface Modification of Advanced Materials by Plasma and Related Technology 演講，對於我們常使用電漿來做實驗的研究團隊來說，這是一次非常好的交流，不僅是電漿的物理機制還有更多的應用參數，都是我們討論的重點。

其中，Ko-Shao Chen 所發表的 Post Treatments of Plasma Polymers for creating Functional Surface and their Applications 讓我印象深刻，裡面的重點在於不同的前處理會有顯著的差異，對於應用方面會有不同的影響。共有 3 種前處理，1.Spin coating organic polymer 2. Oxidation of surface 3. Creating functional surface。

● 10/03（三）早上各國的優秀學者以 Plasma 為軸心進行了一連串與環境綠能相符的演說，內容針對環境、空氣清淨機、燃料電池、太陽能電池、薄膜等進行了極其詳細的演說，明白了太陽能電池元件不能只是一味的追求效率，還要符合現在技術應用與環境維護，才能製作出對世界環保有貢獻的新穎技術元件。

- 上圖為研討會海報介紹

來自澳洲的澳洲科學與工業研究組織的 Anthony B. Murphy 發表了 Solving environmental problems with thermal plasma technology 利用熱電漿的方式成功解決環境的問題。透過研究案例得知可以將廢物或生物質轉化為合成氣，然後可以產生電力或乙醇，減少汙染。

下午各國學者的海報張貼皆是與本人目前的研究相關的研究成果，薄膜的元素摻雜、基板選擇、製作流程、分析種類與方法、成核成長機制、元件結構等等，引起本人興趣並與發表者互相討論學習與研究，討論製作過程及後續應用。

例如 Naho Itagaki 等人所發表的 Zinc-Indium Oxynitride Thin Films for Multiple-Quantum－Well Solar Cells 所探討的 ZION 量子井對太陽能效率的影響與我所研究的部分有相關性，藉由此次研討讓我能與專家面對面談話，收穫良多。

我們研究團隊指導之學生也在下午貼上海報 CO_2 Detection based on Ag-Decorated Carbon Nanotubes 、 Enhanced Field Emission Properties of ZnO Nanorods by Indium Doping 、 Structural and Optical Properties of Ga-Doped ZnO Nanorods with Different Temperature by Hydrothermal Method ...等，並與其他有興趣的學者分享研究經驗互相交流。

藉由張貼海報的過程，不僅可以展示研究成果，並且利用這段時間互相觀摩學習，當我們跟來自於世界各國不同的研究團隊進行交流時，發現不同團隊的研究重點都不盡相同，遇到的瓶頸也不一樣，利用這次的機會互相探討，搭起合作的橋樑，共同研究進步。

● 10/04（四）位於大會會場聆聽演講，並與海報發表者參與討論，過程彼此相互學習，收獲豐碩。

來自於 Samsung Electronics 的專家 Dongchan Kim 對我們做了 Dry Etching Challenges and Perspectives for Future Semiconductor Devices 這場演講，對於目前的生活來說智慧型手機與電腦是我們不可或缺的產品，其中大量使用到

的 DRAM and NAND flash 都面臨一個問題，如果要再繼續發展下去，蝕刻製程將會遇到瓶頸。我們對於這個問題做了熱烈的討論，引發了未來研究的興趣，或許可以想辦法解決。

● 10/04（五）來自京都大學的 Susumu Noda 發表了 Manipulation of Photons by Photonic Crystals 這篇理論，說明了光子晶體能運用在光子通信、信息、倉儲、加工、乃至全球的能源問題。他回顧了一些光子晶體的運用及先進的電漿蝕刻技術，帶著我們了解目前技術的最新狀況。

● 10/06（六）大阪關西國際機場－台灣桃園國際機場。

三、 心得

回顧此次出訪日本六天中，雖然行程緊湊，但對於報告、參訪與討論工作，所達成的目標與成果相當豐碩，對本校提升國際知名度與國際級研究成果都將有莫大助益。本校電子系光電工程研究所，相信可藉由國與國之間互相交流與教育訓練，可獲取相當重要的知識與技能，預計返台後即可開展相關工作，對於研究上可得到最大效益與產能。

這次的研討會內容是我們團隊未來的發展方向，對於蝕刻的條件及物理極限還有元件的應用都是我們下一步的方向，在未來本實驗團隊不僅只是研究理論，更希望能真正地應用在產品上。

攜回第十一屆亞太地區電漿科學與技術研討會論文集各一冊，可供學生做參考，增加國際觀與確立未來研究的方向。

四、 建議事項

希望本校和其他單位除了補助老師出席國際研討會之外，能夠多提供機會補助校內學生與教師出國共同參與大型國際會議，藉由國際研討讓學生更有國際觀且有機會在國際場合發表論文，相信國際研討會會讓學生受益良多。

附錄

2-P64

Enhanced field emission properties of ZnO nanorods by indium doping

[1]B. G. Duan, [1]C. H. Hsiao, [2] S. J. Young, [3]C. S. Huang, [1]S. J. Chang
[1] Department of Electrical Engineering, National Cheng Kung University, Taiwan
[2] Department of Electronic Engineering, National Formosa University, Taiwan
[3] Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan

neel1203@gmail.com

Zinc nitrate tetrahydrate, HMT and indium nitrate, at 85°C. The products were ultrasonically cleaned and heated at 50°C for 30min.

The top-view FESEM image of the pure and In-ZnO nanorods (NRs) is shown in figure 1(a) and (c). It can be seen clearly that the ZnO NRs was uniform hexagonal structure. Figure 1(b) and (d) shows the average lengths are 1.14 μm and 1.24 μm, and their diameters are around 70nm and 90nm, respectively.

The comparison J-E curve of pure and indium-doped ZnO NRs are shown in figure 1(e). Turn on field are 5.4 V/um and 0.8 V/um for pure and indium-doped ZnO NRs at a current density of 0.01mA/cm^2. The turn on field is significantly reduced after indium doping, indicating that electron emission properties were enhanced by doping indium, because indium provides more electrons in the conduction band and act as donors. The well aligned of pure and indium-doped ZnO nanorods were successfully synthesized by hydrothermal methods. The turn on field is significantly improved by doping indium into ZnO nanorods.

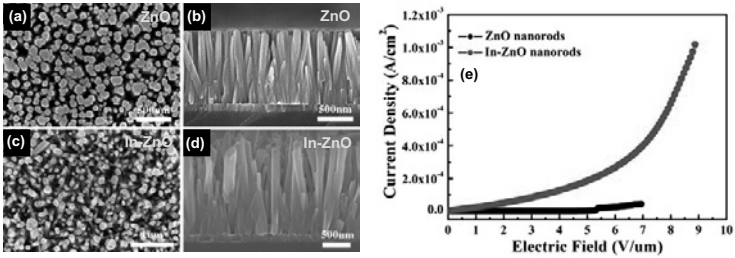


Fig. 1 (a) and (c) top-view FESEM image, (b) and (d) cross-sectional of the pure and indium doped ZnO nanorod grown on glass substrate, respectively. (e) Field emission characteristics of pure and indium-doped ZnO nanorods.

Key Words: In-ZnO nanorods, field emission

2-P73

Growth of Mg-doped ZnO Nanowires by hydrothermal method

[1]S. J. Young, [2]C. H. Hsiao, [3]C. S. Huang, [1]Z. D. Lin , [1]Y. H. Liu[1]
1 Department of Electronic Engineering, National Formosa University, Taiwan
2 Department of Electrical Engineering, National Cheng Kung University, Taiwan
3 Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan

boy080988@gmail.com

Zinc nitrate hexahydrate, magnesium nitrate hexahydrate and methenamine (HMT) at 70 °C to 90°C for 4h. Finally, the substrate was deionized water cleaned and heated at 60°C for 30min.

Figure 1. show top-view FE-SEM images of ZnO and Mg-doped ZnO nanowires were growth temperature of 70°C to 90°C, respectively. It was found that the ZnO and the Mg-doped ZnO nanowires exhibit of hexagonal wurtzite structures with sharp morphology. The UV transmission spectra of the MgZnO nanowires was shifted toward UV-C wavelengths could be attributed to the nanowires because doping with Mg causes an increase in the band gap. The MgZnO nanowires have larger absorption (70°C, 3.44eV) than the ZnO nanowires (90°C, 3.29eV). The transmissivity implied that MgZnO nanowires were successfully fabricated on glass substrate.

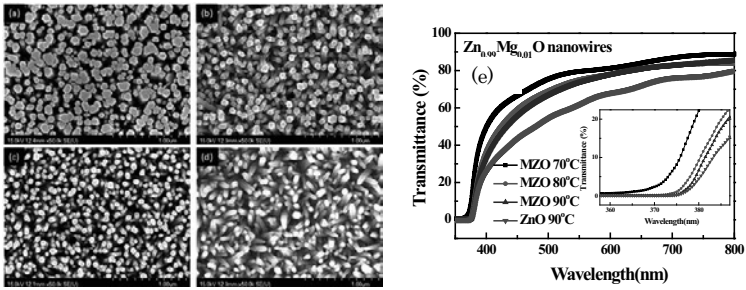


Figure 1. The top-view FE-SEM image of the (a) ZnO nanowires at 90°C and (b), (c), (d) show the Mg-doped ZnO nanowires grown at 70°C, 80°C, and 90°C, respectively. (e) The UV Spectrum of the ZnO and Mg-doped ZnO nanowires.

Key Words: Mg doped ZnO nanowires, energy band gap, transmission spectra

2-P75

High sensitivity for humidity sensor devices with ZnSe nanotips

[1]C. J. Hsiao, [1]C. H. Hsiao, [2]S. J. Young, [3]C. S. Huang, [1]S. J. Chang

[1]Institute of Microelectronics, National Cheng Kung University, Taiwan
[2]Department of Electronic Engineering, National Formosa University, Taiwan
[3]Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan

Q18991227@mail.ncku.edu.tw

The ZnSe nanotips used in this study was grown by molecular-beam epitaxy (MBE) system, using a vapor-liquid-solid (VLS) mechanism with an Au-based nano-catalyst. The sample was grown at 280 °C of the MBE process for 1 hour.

Figures 1(a) and 1(b) display the top view and cross-sectional FESEM images of the ZnSe nanotips prepared on the oxidized Si(100) substrate. The high-density tapering ZnSe nanotips were grown on the insulating SiO_2 layer. In addition, the average length, average diameter, and density of the ZnSe nanotips were 1.2 μm, 57.4 nm, and 1.04×10^7 cm^{-2}, respectively. Figure 2 plots the relative humidity-current as a function of RH without and with UV illumination. The steady state currents were found to be approximately 3.42, 4.03, 6.01, 8.12, and 0.10 μA when measured with RHs of 30 %, 40 %, 50 %, 60%, and 70 %, respectively, with UV illumination.

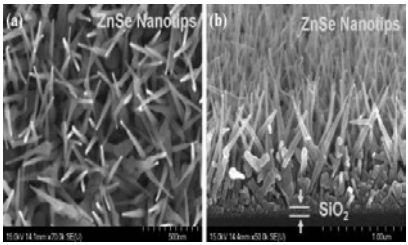


Fig.1(a) top view and (b) cross-sectional FESEM images of the ZnSe nanotips

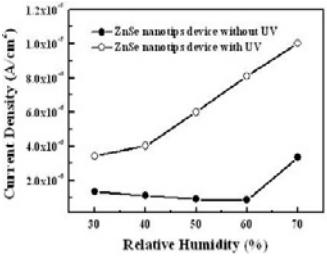


Fig. 2 Comparing UV illumination I-RH characteristics of ZnSe nanotips devices

Key Words: ZnSe nanotips, humidity sensor

2-P102

Structural and Optical Properties of Ga-doped ZnO Nanorods with Different Temperature by Hydrothermal Method

J. J. Guo[1], T. Y. Yang[1,] C. H. Hsiao[2], C. S. Huang[1], S. J. Young[3]

[1]Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan

[2] Department of Electrical Engineering, National Cheng Kung University, Taiwan

[3] Department of Electronic Engineering, National Formosa University, Taiwan

neel1203@gmail.com

Un-doped ZnO nanorods were grown at 90°C and the Ga-doped ZnO nanorods were grown at 70°C, 80°C, 90°C on the glass substrate using hydrothermal method. The duration of the process was 8 hours. The synthesis solution was mixture of zinc nitrate hexahydrate, gallium nitrate hydratend and methenamine.

Figure 1 show top-view FESEM images. The Ga-doped ZnO nanorods grown at 90°C had hexagonal wurtzite structures with sharp morphology.

Figure 2 shows the photoluminescence spectra of nanorods. The PL emission peak were obtain two peaks at approximately 386 and 593 nm, which were ultraviolet emission (UV) and orange emission, respectively. The intensity of UV emission increased, with the growth temperature raised. It can be indicated that the Ga-doped ZnO nanorods grown at 90°C had the best crystalline quality.

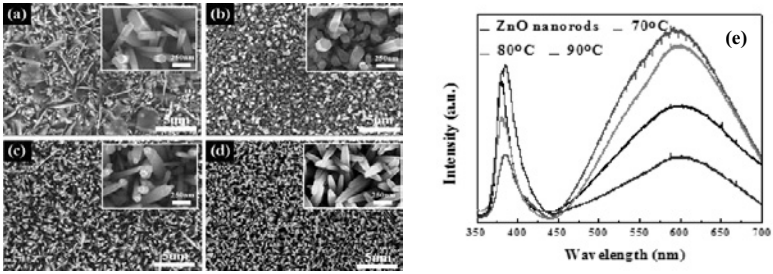


Fig 1. (a), (b), (c) top-view FESEM image of the Ga-doped ZnO nanorods grown at 70°C, 80°C, and 90°C and (d) un-doped ZnO nanorods. Inset in all top-view shows an enlarged FESEM image. (e) Room-temperature PL spectra of the un-doped ZnO and Ga-doped ZnO nanorods.

Key Words: hydrothermal method, Ga-doped ZnO nanorods, sharp morphology

2-P87

Ni-doped ZnO nanorods magnetic properties utilizing aqueous method

T. Y. Yang[1], J. J. Guo[1], C. H. Hsiao[2], C. S. Huang[1], S. J. Young[3]
[1]Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan
[2]Department of Electrical Engineering, National Cheng Kung University, Taiwan
[3]Department of Electronic Engineering, National Formosa University, Taiwan

neel1203@gmail.com

The Ni-doped ZnO nanorods were grown vertically by immersing ZnO seed layer substrate into the prepared solution. The samples were grown for 1 hour at 70°C, 80 °C, 90°C.

Figures 1 (a), (b), (c), (d) show FESEM images of the Ni-doped ZnO nanorod and the pure ZnO nanorod. These nanorods are so crowded that become thin-film. When a change in the growth temperature of 90°C, the nanorods can be seen from the thin-film changed to rod and gradual raised of the projected lengths. It was found the average length and diameters were ~2.08um and around 85.8nm, respectively. Fig. 1 (e) shows the magnetization (M) and magnetic field (H) curve. The coercivites (Hc) and saturation magnetization (Ms) of Ni-doped ZnO nanorods were 79 Oe and 0.66 emu/cm^3 at 90 °C, respectively.

Ni-doped ZnO nanorods were fabricated successfully on seed layer at low temperature. In the SEM image and Magnetic field curve loops, the growth temperature at 90°C has the best nanorod structure.

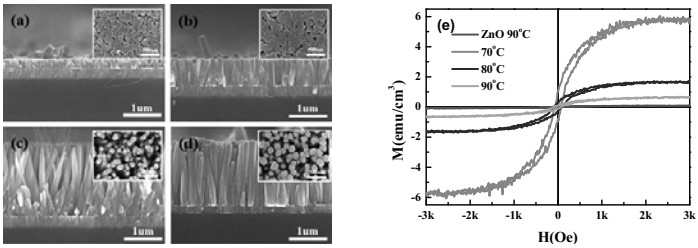


Figure1. (a), (b), (c), (d) shows FESEM image of the Ni-doped ZnO grown at 70°C, 80°C, 90°C, and un-doped ZnO nanorods at 90°C, respectively. Magnetic field curve loops of Ni-doped ZnO nanorod at room temperature.

Key Words: Ni-doped ZnO, nanorod, aqueous method, ferromagnetic

2-P53

CO_2 detection Based on Ag-Decorated Carbon Nanotubes

[1] S. J. Young, [2] C. S. Huang, [3] C. H. Hsiao, and [1] Z. D. Lin
[1] Department of Electronic Engineering National, Formosa University, Yunlin 632, Taiwan
[2] Department of Electrical Engineering, National Cheng Kung University, Taiwan
[3] Graduate school of Optoelectronics, National Yunlin University of Science and Technology, Tainan 701, Taiwan
E-mail: smith02620@gmail.com

The growth of carbon nanotubes was carried out by using thermal CVD system. The quartz tube was heated up to the growth temperature of 700°C, then only C_2H_2 gas was introduced with a flow rate of 30 sccm for the synthesis of CNTs. Ag nanoparticle was deposited on the CNTs surface prepared using an electron-beam evaporator.

Figures 1(a) and 1(b) show cross-sectional and top-view FESEM images, respectively, of the CNTs prepared on Si substrates. It was found that average length and average diameter of the CNTs about ~4.5μm and ~45nm, respectively. Figure 1(c) shows the response and recovery of the CNTs upon exposure to 50, 100, 200, 400 and 800 ppm CO_2 concentrations at room temperatures. The relation between sensitivity and gas ambient concentrations at fixed 5V biased voltage. There were two major results. It was found that the sensitivity was about 3.8% when exposed to 800 ppm CO_2 concentration.

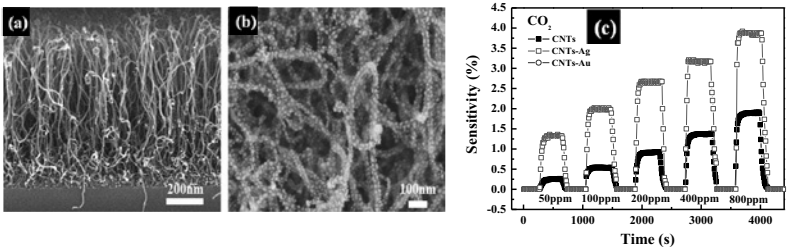


Fig. 1 (a) Cross-sectional and (b) high-magnification top-view FESEM images of the Ag-CNTs grown on Si substrate.(c) Sensor response of our Ag-CNT CO_2 gas sensor measured at various concentration.

Key Words: Carbon nanotubes, Ag nanoparticle, gas sensor

2-P108

Synthesize of ZnO:Li nanorods by hydrothermal method

[1]S. J. Young, [2]C. H. Hsiao, [3]C. S. Huang, [1]Z. D. Lin, [1]L. C. Lai
1 Department of Electronic Engineering, National Formosa University, Taiwan
2 Department of Electrical Engineering, National Cheng Kung University, Taiwan
3 Graduate School of Electronic and Optoelectronic Engineering, National Yunlin University of Science and Technology, Taiwan

abcokklbyc12@yahoo.com.tw

Li-doped ZnO nanorods were synthesized by hydrothermal method. The ZnO seed layer was sputtering on the corning glasses by radio frequency magnetron sputter at room temperature.The ZnO seed layer was sputtering on the corning glasses by radio frequency magnetron sputter at room temperature. The Li-doped ZnO nanorods were grown vertically from seed layer by immersing seed layer substrate in the prepared solution. The samples were grown for 8.5 hour at 80°C.

Figure 1 shows the XRD pattern of Li doped ZnO nanorods when the growth temperature is 80 °C. It was found that the highly intensity obtained of 002 peak, The Li-doped ZnO nanorods exhibit of hexagonal wurtzite structures.

Figure 2 shows the magnetization (M) and magnetic field (H) curve of Li-doped ZnO nanorods. The coercivities (Hc) and saturation magnetization (Ms) of Li-doped ZnO nanorods were 30 Oe and 0.0089 emu/g at 80°C, respectively.

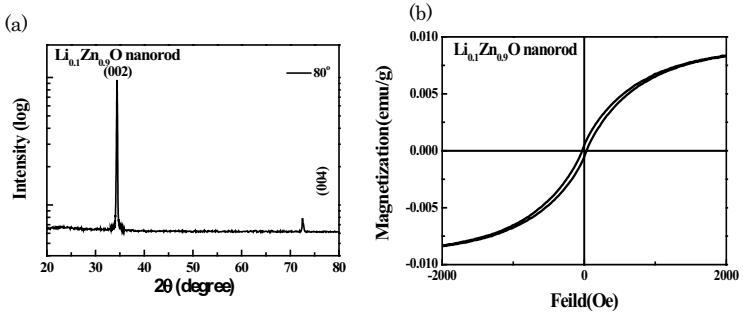


Figure 1. (a) XRD pattern of Li doped ZnO nanorods. (b)Magnetization and magnetic field curve of prepared samples.

Key Words: Li-doped ZnO nanorods, hydrothermal method, magnetic