
# 光電半導體組

## 趙良君 副教授

美國馬里蘭大學博士

研究領域：低維度半導體奈米結構、離子束技術、光電元件

關 鍵 字：奈米結構、氧化鋅、離子束、稀土元素

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一、研究主題與目標

研究方向為低維度氧化鋅奈米結構，含稀土元素半導體，離子束技術及應用。

二、最近研究題目

1. 離子束製成氧化鋅奈米結構
2. 離子束濺鍍沈積氧化鋅薄膜
3. 化學氣相沈積氧化鋅奈米結構
4. 化學氣相沈積氧化鋅薄膜
5. 摻氮 p-型氧化鋅薄膜

三、主要的研究成果與所執行的計劃

論文發表

一、期刊論文


(19) **L. C. Chao**, C. W. Chang and D. Y. Tsai, "Erbium containing ZnO prepared by ion beam sputtering deposition and thermal annealing mixing," Appl. Surf. Sci., in press, 2009.

(18) **L. C. Chao**, J. W. Huang, and C. W. Chang, "Annealing effects on the properties of Nd containing ZnO nanoparticles," Physica B, in press, 2009.

(17) **L. C. Chao**, C. C. Liau, S. J. Lin, and J. W. Lee, "ZnO nanostructures grown on zinc nanocones by thermal oxidation," J. Vac. Sci. Tech. B, vol. 26, pp. 2601-2603, 2008.

(16) **L. C. Chao**, M. Y. Hsieh, and S. H. Yang, "Effect of carrier gas species and flow rates on the properties of ZnO thin films prepared by chemical vapor deposition using zinc acetate dihydrate," Appl. Surf. Sci., vol. 254, pp. 7464-7468, 2008.

(15) **L. C. Chao**, F. C. Tsai, and J. C. Su, "Improvement of photon extraction efficiency of InGaN LEDs utilizing textured ZnO layer deposited by electrospray deposition," Materials Science in Semiconductor Processing, vol. 11, pp. 13-15, 2008.

(14) **L. C. Chao**, J. W. Lee, and C. C. Liau, "ZnO nanoneedles prepared by

ion implantation and thermal oxidation on metallic zinc foils," J. Phys. D: Appl. Phys., vol. 41, p. 115405, 2008.

(13) **L. C. Chao**, H. T. Hu, S. H. Yang, and Y. C. Fan, "Effect of annealing on the properties of (100) ZnO films prepared by chemical vapor deposition utilizing zinc acetate dihydrate," Thin Solid Films, vol. 516, pp. 6305-6309, 2008.

(12) **L. C. Chao**, C. C. Liau, J. W. Lee, and F. C. Tsai, "Fabrication of zinc nanotip arrays by ion beam sputtering," J. Vac. Sci. Tech. B, vol. 25, pp. 2168-2170, 2007.

(11) **L. C. Chao** and S. H. Yang, "Growth and Auger electron spectroscopy characterization of donut-shaped ZnO nanostructures," Appl. Surf. Sci., vol. 253, pp. 7162-7165, 2007.

(10) **L. C. Chao**, P. C. Chiang, S. H. Yang, J. W. Huang, C. C. Liau, J. S. Chen, and C. Y. Su, "Zinc oxide nanodonut prepared by vapor-phase transport process," Appl. Phys. Lett., vol. 88, p. 25111, 2006.

(9) **L. C. Chao**, P. C. Chiang, S. H. Yang, J. W. Huang, C. C. Liau, J. S. Chen, and C. Y. Su, "Erbium doped zinc oxide prepared by vapor phase transport," Jap. J. Appl. Phys., vol. 45, pp. L938-L940, 2006.

(8) B. K. Lee, R. C.-J. Chi, **D. L. -C. Chao**, J. Cheng, I. Y. -N. Chyr, F. R. Beyette Jr., and A. J. Steckl, "High density Er-implanted GaN optical memory devices," Appl. Optics, vol. 40, pp. 3552-3558, 2001.

(7) **L. C. Chao** and A. J. Steckl, "CW blue-green light emission from GaN and SiC by sum-frequency generation and second harmonic generation," J. Electronic Materials, vol. 29, pp. 1059-1061, 2000.

(6) **L. C. Chao**, B. K. Lee, C. J. Chik, J. Cheng, I. Chyr, and A. J. Steckl, "Rare earth focused ion beam implantation utilizing Er and Pr liquid alloy ion sources," J. Vac. Sci. Tech. B, vol. 17, pp. 2791-2794, 1999.

(5) I. Chyr, B. K. Lee, **L. C. Chao**, and A. J. Steckl, "Damage generation and removal in the Ga+ FIB micromachining of GaN for photonic applications," J. Vac. Sci. Tech. B, vol. 17, pp. 3063-3067, 1999.

(4) **L. C. Chao**, B. K. Lee, C. J. Chi, J. Cheng, I. Chyr, and A. J. Steckl "Upconversion luminescence of Er-implanted GaN films by focused-ion-beam direct write," Appl. Phys. Lett., vol. 75, pp. 1833-1835, 1999.

(3) **L. C. Chao** and A. J. Steckl, "Room-temperature visible and infrared photoluminescence from Pr-implanted GaN films by focused-ion-beam direct write," Appl. Phys. Lett., vol. 74, pp. 2364-2366, 1999.

(2) **L. C. Chao** and A. J. Steckl, "Development of an Er-Ni liquid alloy ion source," J. Vac. Sci. Tech. B, vol. 17, pp. 1056-1059, 1999.

(1) **L. C. Chao**, J. Orloff, and Li Wang, “Spherical aberration corrector using space charge,” J. Vac. Sci. Tech. B, vol. 15, pp. 2732-2736, 1997.

二、國際研討會論文

(1) L. C. Chao, C. C. Cliau, “The effect of porosity of metal zinc films on the formation of ZnO prepared by thermal oxidation”, Mater. Res. Soc. Symp. Proc. 1012-Y03-17 (2007).

(2) L. C. Chao “Zonal spherical aberration correction utilizing axial electrode” Proc. SPIE 5592 (2005) 413-420

專利

(1) US Patent 6,255,699 B1 “Visible light emitting device formed from wide band gap semiconductor doped with a rare earth element” R. H. Birkhahn, **L. C. Chao**, M. J. Garter, J. D. Scofield, and A. J. Steckl, July 2001.

(2) US Patent 6,406,930 B1 “Fabrication of visible light emitting device formed from wide band gap semiconductor doped with a rare earth element” R. H. Birkhahn, **L. C. Chao**, M. J. Garter, J. D. Scofield, and A. J. Steckl, June 2002.

執行計劃:

1. “含稀土元素氧化鋅之成長及量測分析”，國科會 94-2112-M-011-001
2. ”含稀土元素氧化鋅奈米結構生長及量測”， 國科會 94-2112-M-011-003
3. “含鉕氧化鋅奈米結構生長及量測” ，國科會 96-2112-M-011-003
4. “化學氣相沈積氧化鋅研究及離子束製成奈米結構” ，國科會 97-2112-M-011-002
5. “層狀奈米結構場發射特性研究”，臺灣科技大學與俄羅斯聖彼得堡大學合作案 RP07-06。


# Optoelectronics and Semiconductor Group
## Associate Professor Liang C. Chao

Ph.D., University of Maryland at College Park, U.S.A.
Field of study: Low dimensional semiconductor nanostructures
Ion beam technology and applications
Optoelectronic devices
Key words: Nanostructures, ZnO, ion beam, rare earth element
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1. The Subject and Aims of Research

Our research interests are ZnO nanostructures, rare earth doped semiconductor materials, ion beam technology and applications.

2. Recent Research Activities

a. Ion beam fabrication of ZnO nanostructures.
b. Ion beam sputtering deposition of ZnO thin films
c. Growth of ZnO nanostructures by chemical vapor deposition
d. Deposition of ZnO thin films by chemical vapor deposition
e. p-type ZnO thin films

3. Publications, Pattents and Projects

Publications:

a. SCI papers


(19) **L. C. Chao**, C. W. Chang and D. Y. Tsai, "Erbium containing ZnO prepared by ion beam sputtering deposition and thermal annealing mixing," Appl. Surf. Sci., in press, 2009.

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b. International Conference Papers

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Patents

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Projects

(1) "Growth and characterization of rare earth doped zinc oxide", NSC 94-2112-M-011-001. $961,400

(2) "Growth and characterization of rare earth doped zinc oxide nanostructures", NSC 94-2112-M-011-003. $973,000

(3) "Growth and characterization of erbium doped ZnO", NSC 96-2112-M-011-003. $1,057,000

(4) "Study of ZnO prepared by chemical vapor deposition and fabrication of nanostructures by ion beam sputtering", NSC 97-2112-M-011-002. $970,000

(5) "Field emission properties of multi-layered nanostructure systems", Joint research of St. Petersburg State University and National Taiwan University of Science and Technology, RP07-06.