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## **Gensheng Huang, Ph.D.**

### **Contact Information**

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### **Education**

Apr. 2000- Sept.1997 **Ph. D** in Semiconductor materials and devices physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai, China.

July 1997- Sept.1994 **MSc** in Semiconductor materials and devices physics, Institute of Crystal Materials (Chinese State Key Lab), Shandong University, Jinan, China.

July 1987- Sept.1983 **B. A.Sc**, Department of Physics, Shandong University, Jinan, China.

### **Professional and Research Experience**

#### **Aug. 2007- Present: Postdoctoral Research Associate**

Center for Optical Technologies, Department of Electrical and Computer Engineering  
Lehigh University, PA 18015, USA

InGaN/GaN high efficiency green light emitting diodes (LEDs), AlInN/GaN intersubband transition lasers and InN/Ga(In)N solar cell grown by **VEECO MOCVD (EMCORE P75)**.

- Design and optimize III-nitride materials and devices growth and re-growth processes
- Using microscope, Hall measurement, SEM, PL and CL to calibrate materials and devices.
- In charge of MOCVD Lab safety and maintenance.
- Training Ph.D candidates and graduate students.

#### **June, 2004- July, 2007: Postdoctoral Research fellow**

Department of Photonics & Institute of Electro-Optical Engineering, National Chiao Tung University, Taiwan.

#### **Job description:**

GaN based light emitting diodes (LEDs), Microcavity light emitting diodes (MCLED), vertical cavity surface emitting lasers (VCSELs) grown by **VEECO MOCVD (EMCORE D75)**.

- Fabrications of high reflectivity and crack-free AlN/GaN distributed Bragg reflectors and vertical cavity surface emitting laser.

- Fabrication of InGaN and GaN quantum dots and nanorod of InGaN/GaN MQW.
- Design processes to enhance the light output power of light emitting diodes.
- High Al composition and high hole concentration AlGaIn grown by pulsed atomic-layer epitaxy using MOCVD.
- Using photoluminescence, AFM, SEM, XRD, Hall measurement, current-voltage and capacitance-voltage electronic system to measure semiconductor materials and devices.
- Fabrications of GaN based devices such as high brightness LED, RCLED and VCSEL. Using electronic beam to evaporate the p and n-type contact. Using PECVD to deposit SiO<sub>2</sub> and SiN<sub>x</sub>. Using inductive coupled plasma (ICP) to form the mesa.

**Aug. 2000- Dec. 2003: Research Fellow**

School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore.

Job description:

- Develop and refine growth and re-growth processes for improved performance and reliability using **Aixtron 200 MOCVD system**.
- Fabrication of high power laser (808nm) based on AlGaAs/GaAs and GaInAsP single quantum well. Do all the devices processes of photolithography and electronic beam evaporation and ICP.
- Design optimally all growth processes.
- Recommend process/equipment improvements.
- Provide training/mentoring to operators and write the operation specifications.
- Give direction to equipment technicians and participate in equipment maintenance and repair.
- Using characterization tools (Photoluminescence, AFM, SEM, XRD, Hall measurement and ECV profiling) to calibrate materials and devices.

**1992-1994 Lecturer**

Department of Physics of Normal School Fuzhou, Jiangxi province, P. R. China  
Teach mechanics, electromagnetics.

**1987-1992 Engineer**

Xihe Machine Pte Ltd, Jiangxi Province, P. R. China.

**Professional Affiliations**

2006 – Present, Member, Material Research Society (MRS)

2007 – Present, Member, Sigma Xi Research Society

**REFEREED JOURNAL PUBLICATIONS LIST**

1. **(Invited Journal Paper)** H. Zhao, G. Liu, X.H. Li, R. A. Arif, **G. S. Huang**, J. D. Poplawsky, S. T. Penn, V. Dierolf, and N. Tansu, "Design and Characteristics of Staggered InGaN Quantum Wells Light-Emitting Diodes in Green Spectra Regime," *IET Optoelectronics* (accepted with minor revisions).
2. H. Zhao, G. Liu, X. Li, **G. S. Huang**, J. D. Poplawsky, S. Tafon Penn, V. Dierolf, and N. Tansu, "Growths of Staggered InGaN Quantum Wells Light-Emitting Diodes Emitting at 520-525 nm Employing Graded-Temperature Profile," *Appl. Phys. Lett.*, **95**, (2009) 061104
3. Tien-Chang Lu, Chih-Chiang Kao, Hao-Chung Kuo, **G. S. Huang**, and Shing-chung Wang, "CW lasing of current injection blue GaN-based vertical cavity surface emitting laser" *Appl. Phys. Lett.*, **92** (2008) 141102.
4. **G. S. Huang**, T. C. Lu, H. H. Yao, H.C. Kuo, S. C. Wang, Chih-wei Lin, Li Chang "Crack-free AlN/GaN distributed Bragg reflectors incorporated with AlN/GaN superlattices grown by

- metalorganic chemical vapor deposition" Appl. Phys. Lett., **88** (2006) 061904.
5. H. H. Yao, T. C. Lu, **G. S. Huang**, C. Y. Chen, W. D. Liang, H. C. Kuo and S. C. Wang "InGaN self-assembled quantum dots grown by metal-organic chemical vapor deposition with growth interruption" Nanotechnology **17** (2006) 1713-1716.
  6. **G. S. Huang**, H. H. Yao, T. C. Lu, H.C. Kuo, S. C. Wang "Aluminum incorporation into AlGaIn grown by low-pressure metalorganic vapor phase epitaxy", J. of Appl. Phys., **99** (2006) 104901.
  7. **G. S. Huang**, H. H. Yao, H.C. Kuo, S. C. Wang, "Effect of growth conditions on the Al composition and quality of AlGaIn film", Materials Science & Engineering B, **136** (2007) 29-32.
  8. **G. S. Huang**, T. C. Lu, H. H. Yao, H.C. Kuo, S. C. Wang, Greg Sun, Chih-wei Lin, Li Chang, "GaN/AlGaIn active regions for terahertz quantum cascade lasers grown by low pressure metal organic vapor deposition", J. Cryst. Growth, **298** (2007) 687-690.
  9. T. S. Ko, T. C. Wang, R. C. Gao, H. G. Chen, **G. S. Huang**, T. C. Lu, H. C. Kuo, S. C. Wang, "Study on optimal growth condition of a-plane GaN grown on r-plane sapphire by metal-organic chemical vapor deposition", J. Cryst. Growth, **300** (2007) 308-313.
  10. T. S. Ko, T. C. Wang, H. G. Chen, R. C. Gao, **G. S. Huang**, T. C. Lu, H. C. Kuo, S. C. Wang, "Observations on surface morphologies and dislocations of a-plane GaN grown by metal organic chemical vapor deposition", Phys. Status Solidi (c), **4** (2007) 2510-2514.
  11. Shing-Chung Wang, Tien-Chang Lu, Chih-Chiang Kao, Jong-Tang Chu, **G. S. Huang**, Hao-Chung Kuo, Shih-Wei Chen, Tsung-Ting Kao, Jun-Rong Chen, and Li-Fan Lin "Optically Pumped GaN-based Vertical Cavity Surface Emitting Lasers: Technology and Characteristics", Jpn. J. Appl. Phys., Vol. **46**, No. 8B (2007) 5397-5407.
  12. **G. S. Huang**, H. C. Kuo, M. H. Lou, T. C. Lu and S. C. Wang "Improvement of efficiency and ESD characteristics of ultraviolet light emitting diode by inserting AlGaIn layer and SiN treatment" J. Cryst. Growth, **305** (2007) 55-58.
  13. **G. S. Huang**, H. G. Chen, J. R. Chen, T. C. Lu, H.C. Kuo, S. C. Wang "Crack-free epitaxial nitride microcavity using highly reflective AlN/GaN and Ta<sub>2</sub>O<sub>5</sub>/SiO<sub>2</sub> Bragg mirrors" Phys. Status Solidi (a), **204** (2007)1977-1981.
  14. **G. S. Huang**, T. C. Lu, H. C. Kuo, S. C. Wang, H. G. Chen, "Fabrication of microcavity light emitting diodes using highly reflective AlN/GaN and Ta<sub>2</sub>O<sub>5</sub>/SiO<sub>2</sub> distributed Bragg mirrors" Photonics Technology Letters **19** (2007) 999-1001.
  15. **G. S. Huang**, X. H. Tang, B. L. Zhang, Y. C. Zhang, Swee Chuan Tjin "MOVPE growth InAs/GaAs quantum dots using tertiarybutylarsine(TBA) in pure N<sub>2</sub> ambient", J. Cryst. Growth, **268** (2004) 444-448.
  16. B. L. Zhang, X. H. Tang, **G. S. Huang**, and J. Y. Zhu, " Study of InGaAsP and GaInP layers grown by MOCVD in pure N<sub>2</sub> ambient for InGaAsP/GaAs single QW LD structures" J. Cryst. Growth, **268** (2004) 396-400.
  17. Baoxue Bo, Xiaohong Tang, Baolin Zhang, **G. S. Huang**, Yuanchang Zhang, Tjin Swee Chuan, " Lasing properties of AlGaAs/GaAs material diode lasers grown by MOCVD using TBA in N<sub>2</sub> ambient", J. Cryst. Growth **268** (2004) 415-419.
  18. J. H. Zhao, X. H. Tang, T. Mei, B. L. Zhang, **G. S. Huang**, "MOCVD growth of InGaAsP/InGaAs multi-step-quantum well structure for QWIP application by using TBA and TBP in N<sub>2</sub> ambient", J. Cryst. Growth **268** (2004) 432-436.
  19. Baoxue Bo, Xiaohong Tang, Baolin Zhang, **G. S. Huang**, Yuanchang Zhang, and Tjin Swee Chuan, "AlGaAs/GaAs Quantum Well Lasers Grown by Metalorganic Chemical Deposition Using Tertiarybutylarsine in Nitrogen Ambient" Jpn. J. Appl. Phys., Part 1 **43** (2004) 3410.
  20. X. H. Tang, S. J. Chua, B. L. Zhang, J. Y. Zhu, **G. S. Huang**, "Optically induced blueshift of photoluminescence excitation spectrum in n-i-p-i multiple quantum well structures ", Superlattices and Microstructures , **32**, Issue: 2-3, (2002) pp. 135-144.
  21. B. L. Zhang, X. H. Tang, **G. S. Huang**, T. Mei, J. Y. Zhu and H. Li, "Morphology and optical

- properties of GaAs layers grown on (111)A GaAs substrates in N<sub>2</sub> ambient by metalorganic chemical vapor deposition" *Journal of Materials Science: Materials in Electronics*. **15** (2004) 283-286.
22. **G. S. Huang**, X. H. Tang, B. L. Zhang, Swee Chuan Tjin, "Arsenic incorporation into InGaAsP GaAs-based material grown by low pressure metalorganic chemical vapor deposition using tertiarybutylarsine and tertiarybutylphosphine in pure N<sub>2</sub> ambient", *J. of Appl. Phys.*, **94**(8) (2003) 4890-4895.
  23. **G. S. Huang**, X. H. Tang, B.L.Zhang, "MOVPE growth of Si-doped GaAs and Al<sub>x</sub>Ga<sub>1-x</sub>As using tertiarybutylarsine (TBA) in pure N<sub>2</sub> ambient", *Materials Science in Semiconductor Processing*, **6** (2003) 171-174.
  24. Z. -F. Li, W. Lu, **G. S. Huang**, J. R. Yang, L. He and S. C. Shen, "Micro photoluminescence Mapping on CdZnTe:Zn Distribution", *J. of Appl. Phys.*, **90**(1), (2001) 260.
  25. **G. S. Huang**, X.-Q. Chen, J.-R. Yang, L. He, "Growth and Characterization of Liquid-phase Epitaxial Hg<sub>1-x</sub>Cd<sub>x</sub>Te Films", *J. of Infrared and Millimeter Waves*, **19**(1) (2000) 132.
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29. **G. S. Huang**, H. G. Chen, T. C. Lu, T. T. Kao, H. H. Yao, H. C. Kuo, and S. C. Wang, "Crack-free epitaxial nitride microcavity using highly reflective AlN/GaN and Ta<sub>2</sub>O<sub>5</sub>/SiO<sub>2</sub> Bragg mirrors", Oral, International Workshop on Nitride Semiconductors (IWN 2006), 22-27 October Kyoto, Japan, pp. 830-833, 2006.
30. **G.S. Huang**, H. H. Yao, Y. T. Wang, T. C. Lu, H.C. Kuo, S. C. Wang and L. -H. Peng, "Infrared reflectance of optic phonon modes in AlGaN epitaxial layers grown on sapphire substrates", Oral, Spring meeting of Material Research Society (MRS 2006 spring) 17-21, April, San Francisco, USA, 2006.
31. **G. S. Huang**, T. C. Lu, H. H. Yao, H.C. Kuo, S. C. Wang, Chih-wei Lin, Li Chang "Growth of crack free AlN/GaN DBR structure with the insertion of AlN/GaN superlattices", Oral, 3<sup>rd</sup> International Conference on Materials for Advanced Technologies (ICMAT2005) and 9<sup>th</sup> International Conference on Advanced Materials (ICMA 2005) 3-8 July, Singapore, 2005.
32. **G. S. Huang**, X. H. Tang, B. L. Zhang, Y. C. Zhang, Swee Chuan Tjin "MOVPE growth InAs/GaAs quantum dots using tertiarybutylarsine(TBA) in pure N<sub>2</sub> ambient", Poster, 2<sup>nd</sup> International Conference on Materials for Advanced Technologies (ICMAT2003) and 8<sup>th</sup> International Conference on Advanced Materials (ICMA 2003) 7-12 December, Singapore, 2003.
33. **G. S. Huang**, J. Yang, X. Chen, W. Fang, Z. Huang, L. He, "Study of Interdiffusion in

- HgCdTe/CdZnTe Structure by Infrared Transmission Spectroscopy", SPIE, Proc., Vol 4086 (2000) p270-273.
34. **(Invited Conference Paper)** N. Tansu, H. Zhao, R. A. Arif, Y. K. Ee, G. Liu, X. Li, H. Tong, and **G. S. Huang**, "Novel Approaches for Efficiency Enhancement in InGaN-Based Light-Emitting Diodes," in Proc. of the 2nd International Conference on White LEDs and Solid State Lighting 2009, Taipei, Taiwan, December 2009.
  35. **(Invited Conference Paper)** N. Tansu, H. Zhao, Y. K. Ee, G. Liu, X. H. Li, and **G. S. Huang**, "Novel Device Concept for High-Efficiency InGaN Quantum Wells Light-Emitting Diodes," in Proc. of the SPIE Photonics West 2010, Gallium Nitride Materials and Devices V, San Francisco, CA, Jan 2010
  36. **(Invited Conference Paper)** N. Tansu, H. Zhao, Y. K. Ee, G. Liu, X. H. Li, J. Zhang, S. F. Zhang, and **G. S. Huang**, "Novel Growth and Device Concepts for High-Efficiency InGaN Quantum Wells Light-Emitting Diodes," in Proc. of the IEEE/OSA Conference on Lasers and Electro-Optics (CLEO) 2010, San Jose, CA, May 2010
  37. Hongping Zhao, Guangyu Liu, Xiaohang Li, Ronald A. Arif, **G. S. Huang**, Yik-Khoon Ee, and Nelson Tansu, "Growth of staggered InGaN quantum well light-emitting diodes emitting at 520-525 nm employing graded temperature profile" Proc. SPIE **7231** 72310E 2009.
  38. Hongping Zhao, Hua Tong, Alexandra M. Driscoll, Muhammad Jamil, **G. S. Huang**, and Nelson Tansu, "Characteristics of narrow-band gap InN semiconductors grown on Ga-polar and N-polar GaN templates by pulsed metalorganic vapor phase epitaxy" Proc. SPIE **7216** 72160L, 2009.
  39. H. Zhao, **G. S. Huang**, G. Liu, X. Li, J. D. Poplawsky, S. Tafon Penn, V. Dierolf, and N. Tansu, "Characteristics of Staggered InGaN Quantum Wells Light-Emitting Diodes Emitting at 480-525 nm." in Proc. of the 67th IEEE Device Research Conference (DRC) 2009, University Park, PA, June 2009.
  40. H. Zhao, M. Jamil, G. Liu, **G. S. Huang**, H. Tong, G. Xu, Y. J. Ding, N. Tansu, "Pulsed Metalorganic Vapor Phase Epitaxy of In-Polar and N-Polar InN Semiconductors on GaN / Sapphire Templates for Terahertz Emitters," Oral, in Proc. of the IEEE/OSA Conference on Lasers and Electro-Optics (CLEO) 2009, Baltimore, MD, May 2009.
  41. H. Zhao, G. Liu, X. Li, **G. S. Huang**, S. Tafon Penn, V. Dierolf, and N. Tansu, "Staggered InGaN Quantum Wells Light-Emitting Diodes at 520-nm Employing Graded Temperature Growths," Oral, in Proc. of the IEEE/OSA Conference on Lasers and Electro-Optics (CLEO) 2009, Baltimore, MD, May 2009.
  42. G. Sun, S. K. Tripathy, Y. J. Ding, G. Liu, **G. S. Huang**, H. Zhao, N. Tansu, and J. B. Khurgin, "Stark Effect Induced by Photogenerated Carriers in Multiple GaN/AlN Asymmetric Coupled Quantum Wells," Oral, in Proc. of the IEEE/OSA Conference on Lasers and Electro-Optics (CLEO) 2009, Baltimore, MD, May 2009.
  43. **(Invited Conference Paper)** N. Tansu, R. A. Arif, Y. K. Ee, H. Zhao, H. Tong, M. Jamil, and **G. S. Huang**, "Nano-Engineering of III-Nitride Semiconductor Optoelectronics and New Applications," Oral, in Proc. of the International Conferences of Materials and Technologies (CIMTEC) 2008 – 3rd International Conference on Smart Materials, Structures and Systems, Sicily, Italy, June 2008.
  44. Hongping Zhao, Ronald A. Arif, **G. S. Huang**, Yik-Khoon Ee, and Nelson Tansu, "Self-Consistent Optical Gain Analysis and Epitaxy of Strain-Compensated InGaN-AlGaIn Quantum Wells for Laser Applications", Oral, IEEE / OSA Conference on Lasers and Electro-Optics (CLEO), 2008.

45. **(Invited Conference Paper)** N. Tansu, R. A. Arif, H. Zhao, **G. S. Huang**, and Y. K. Ee, "Polarization Engineering of III-Nitride Nanostructures for High-Efficiency Light Emitting Diodes," Oral, in Proc. of the SPIE Optics + Photonics 2008, The 8<sup>th</sup> International Conference on Solid State Lighting, vol. 7058, paper 7058-45, San Diego, CA, August 2008.
46. **(Invited Conference Paper)** N. Tansu, H. Zhao, R. A. Arif, Y. K. Ee, G. Liu, X. Li, and **G. S. Huang**, "Polarization Engineering of InGaN-Based Nanostructures for Low-Threshold Diode Lasers and High-Efficiency Light Emitting Diodes," Oral, in Proc. of the IEEE Photonics Global 2008, Nanophotonics Symposium, Singapore, Republic of Singapore, December 2008.
47. Jun-Rong Chen, Tien-Chang Lu, **G. S. Huang**, Tsung-Shine Ko, Hao-Chung Kuo, Shing-Chung Wang, "Infrared reflectance of optical phonon modes in AlGaIn epitaxial layers grown on sapphire substrates" SPIE Photonics 19-24 January 2008, San Jose, California USA, 2008.
48. Ming-Hua Lo, Tien-Chang Lu, Hao-Chung Kuo, Shing-Chung Wang, Jun-Rong Chen, Tsung-Shine Ko, Zhen-Yi Li, **G. S. Huang**, "Atomic-layer deposition of high-quality  $\text{Al}_x\text{Ga}_{1-x}\text{N}/\text{GaN}$  multiple quantum wells by MOCVD" SPIE Photonics 19-24 January, San Jose, California USA, 2008.
49. Tien-chang Lu, Chih-chang Kao, **G. S. Huang**, Hao-chung Kuo, and Shing-chung Wang "VCSELs and Microdisk Lasers", Oral, CLEO/Pacific Rim, 26-31, August, 2007 Seoul, Korea.
50. T. C. Lu, C. C. Kao, H. W. Huang, J. T. Chu, **G. S. Huang**, H. C. Kuo and S. C. Wang, "Light enhancement in GaN-based emitters by nano-fabrication technique", Oral, 5th Cross-strait workshop on Nanoscience and Nanotechnology, 9-11 December, 2006, Hong Kong (2006).
51. H. C. Kuo, T. C. Lu, Y.J. Lee, **G. S. Huang**, and S. C. Wang, "Improvement in the Extraction Efficiency of AlGaInP and GaN Thin Film LEDs Via n-Side Surface Roughing", Oral, 210th ECS MEETING, 29 October- 3 November, Cancun, Mexico. (2006).
52. H. Yao, H. G. Chen, **G. S. Huang**, T. C. Lu, H. C. Kuo, S. C. Wang, "High Quality and Crack-Free AlN/GaN Distributed Bragg Reflector Grown by Metal Organic Chemical Vapor Deposition" 13th International Conference on Metal Organic Vapor Phase Epitaxy, 22-26 May, Miyazaki, Japan. (2006).
53. H. H. Yao, **G. S. Huang**, T. C. Lu, H. C. Kuo and S. C. Wang, "Effects of growth interruption time on InGaIn/GaN quantum dots size grown by metal organic chemical vapor deposition", in Gallium Nitride materials and devices, Vol 6121, part of SPIE's Integrated Optoelectronics Devices, 2006 San Jose, CA, USA. (2006).

## **PATENT**

1. **G.S. Huang**, H. H. Yao, H.C. Kuo, S. C. Wang "Process for fabricating group III nitride based reflectors" (Taiwan patent, pending Japan patent)

## **Selected Research Works Featured in Magazine / Newspapers**

“The first electrically injected blue-emitting VCSEL operates at 77 K” in Laser Focus World and Compound Semiconductor News

[http://www.laserfocusworld.com/display\\_article/330730/12/none/none/NBrea/The-first-electrically-injected-blue-emitting-VCSEL-operates-at-77-](http://www.laserfocusworld.com/display_article/330730/12/none/none/NBrea/The-first-electrically-injected-blue-emitting-VCSEL-operates-at-77-)

and

<http://compoundsemiconductor.net/cws/article/news/33855>

### Journal Reviewer

1. IEEE Journal of Selected Topics in Quantum Electronics (published by IEEE LEOS) (6 papers)
2. Journal of Crystal Growth (published by Elsevier Science) (one paper)

### Internal Scientific Lectures & Seminars (Non-Refereed)

1. H. Zhao, R. A. Arif, Y. K. Ee, **G. S. Huang**, and N. Tansu, “Self-Consistent Optical Gain Analysis and Epitaxy of Strain Compensated InGaN-AlGaN Quantum Well Active Regions for Laser Applications,” Poster in *Lehigh Center for Optical Technologies (COT) Open House 2008, Lehigh University*, Bethlehem, Pennsylvania, USA, October 2008.
2. H. Zhao, R. A. Arif, Y. K. Ee, **G. S. Huang**, and N. Tansu, “Design Analysis of Staggered InGaN Quantum Well Diode Lasers Emitting at 500-nm,” Poster in *Lehigh Center for Optical Technologies (COT) Open House 2008, Lehigh University*, Bethlehem, Pennsylvania, USA, October 2008.
3. N. Tansu, R. A. Arif, H. Zhao, Y. K. Ee, **G. S. Huang**, G. Liu, and X. Li, “High Efficiency III-Nitride Light-Emitting Diodes for Solid State Lighting,” Oral Presentation in *Lehigh Center for Optical Technologies (COT) Open House 2008, COT Workshop on Solid State Materials for Energy Applications, Lehigh University*, Bethlehem, Pennsylvania, USA, October 2008.
4. N. Tansu, M. Jamil, H. Zhao, G. Liu, and **G. S. Huang**, “Toward InGaN-Based Solar Cells,” Oral Presentation in *Lehigh Center for Optical Technologies (COT) Open House 2008, COT Workshop on Solid State Materials for Energy Applications, Lehigh University*, Bethlehem, Pennsylvania, USA, October 2008.

### References

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#### 2. Prof. Thomas L. Koch

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