

References

1. Hsieh, J. J. Liquid-Phase Epitaxy. in T. S. Moss (ed.), **Handbook on semiconductors**, pp. 415-492. New York : North-Holland Publishing, 1980.
2. Cho, A. Y. Twenty years of molecular beam epitaxy. **J. Crystal Growth**. 150(1995) : 1-6.
3. Cho, A. Y. Morphology of epitaxial growth of GaAs by a molecular beam method : The observation of surface structures. **J. Appl. Phys.** 41(1970) : 2780-2786.
4. Sze, S. M. **VLSI technology**. Singapore : McGraw-Hill, 1987.
5. Joyce, B. A., et al. Dynamics and kinetics of MBE growth. **J. Crystal Growth**. 115(1991) : 338-347.
6. Göbel, E. O., and Ploog, K. Fabrication and optical properties of semiconductor quantum wells and superlattices. **Prog. Quant. Electr.** 14(1990) : 289-356.
7. Herman, M. A., and Sitter, H. **Molecular beam epitaxy : Fundamentals and current status**. Germany : Springer-Verlag, 1989.
8. Neave, J. H., Joyce, B. A., Dopson, P. J., and Norton, N. **Appl. Phys.** A31(1983) : 1. cited in Herman, M. A., and Sitter, H. **Molecular beam epitaxy : Fundamentals and current status**. Germany : Springer-Verlag, 1989.
9. Ilegems, M. Properties of III-V layers : Optical properties. in E.H.C. Parker (ed.), **The technology and physics of molecular beam epitaxy**, pp. 96-115. London : Plenum Press, 1985.

10. Adachi, S. GaAs, AlAs, and $\text{Al}_x\text{Ga}_{1-x}\text{As}$: Material parameters for use in research and device applications. **J. Appl. Phys.** 58(1985) : R1-R29.
11. Esaki, L. Compositional superlattices. in E.H.C. Parker (ed.), **The technology and physics of molecular beam epitaxy**, pp. 143-184. London : Plenum Press, 1985.
12. Panyakeow, S. Towards high efficiency solar cells. **Annual Conference of the Engineering Institute of Thailand, Under H.M. The King's Patronage** (August 1995).
13. Adachi, S. GaAs, AlAs, and $\text{Al}_x\text{Ga}_{1-x}\text{As}$: Material parameters for use in research and device applications. **J. Appl. Phys.** 53(1985) : R1-R29.
14. Crook, G. E., Tapfer, L., Dweritz, L., Cingolani, R., and Ploog, K. Control of initial surface configuration for GaAs-on-Si MBE using a Si buffer layer? **J.Crystal Growth.** 111(1991) : 184-188.
15. Hashimoto, A., Sugiyama, N., and Tamura, M. Reduction of dislocation density in GaAs on Si substrate by Si interlayer and initial Si buffer layer. **Jpn.J.Appl.Phys.** 30(1991) : L447-L450.
16. Fischer, R., Neuman, D., Zabel H., and Morkoç, H. Dislocation reduction in epitaxial GaAs on Si (100). **Appl.Phys.Lett.** 48(1986) : 1223-1225.
17. Rao, T. S., and Horikoshi, Y. Growth of $(\text{GaAs})_{1-x}(\text{Si}_2)_x$ metastable alloys using migration-enhanced epitaxy. **J.Crystal Growth** 115(1991) : 328-332.
18. Rao, T. S., Nozawa K., and Horikoshi, Y. Structural properties of $(\text{GaAs})_{1-x}(\text{Si}_2)_x$ layers on GaAs(100) substrates grown by migration-enhanced epitaxy. **Jpn.J.Appl.Phys.** 30(1991) : L547-L550.
19. Rao, T. S., Nozawa K., and Horikoshi, Y. Migration enhanced epitaxy of GaAs on Si with $(\text{GaAs})_{1-x}(\text{Si}_2)_x$ / GaAs strained layer superlattice buffer layers. **Appl.Phys.Lett.** 62(1993) : 154-156.

20. Kao, Y. C., Liu, H. Y., Tsai, H. L., Duncan, W. M., Kim, T. S., and Shichijo, H. Molecular beam epitaxial growth of high-quality GaAs on Si using a high-temperature *in situ* annealing process. **J.Vac.Sci.Technol.** B8,2(1990) : 250-253.
21. Frankel, M. Y., Tadayon, B., and Carruthers, T. F. Integration of low-temperature GaAs on Si substrates. **Appl.Phys.Lett.** 62,3(1993) : 255-257.
22. Nozawa, K. and Horikoshi, Y. Misorientation in GaAs on Si grown by migration-enhanced epitaxy. **Jpn.J.Appl.Phys.** 32(1993) : 626-631.
23. Liu, X., Lee, H. P. and Wang, S. Double-heterostructure AlGaAs/GaAs lasers grown on the mesas of trench Si substrate by molecular beam epitaxy. **Electronics Lett.** 26,9(1990) : 590-592.
24. De Boeck, J., Zou, G., Van Rossum, M., and Borghs, G. Mesa release and deposition used for GaAs-on-Si MESFET fabrication. **Electronics Lett.** 27(1991) : 22-23.
25. Hammerl, E., Wittmann, F., Messarosch, J., Eisele, I., Huber, V. and Oppolzer, H. High definition mesa growth by silicon MBE. **Mat.Res.Soc.Symp.Proc.** 220,27 (1991) : 27-33.
26. Hammerl, E., and Eisele, I. Local silicon molecular beam epitaxy with microshadow masks. **Appl.Phys.Lett.** 62(1993) : 2221-2223.
27. Amick, J. A. Cleanliness and the cleaning of silicon wafers. **Solid State Technology.** (1976) : 47-52.
28. Hasnian, G., Mars, D., Döhler, G. H., Ogura, M., and Smith, J. S. Doping superlattice grown in channeled GaAs substrates by molecular beam epitaxy through a built-in shadow mask. **Appl. Phys. Lett.** 51(1987) : 831-833.
29. Agrawal, G .P., and Dutta, N. K. **Semiconductor lasers** (2nd ed.). New York : Van Nostrand Reinhold, 1993.

Appendix

List of Publications

1. **Sopitpan, S., Panyakeow, S., Eisele, I., Totemeyer, K., and Eberl, K. Local Epitaxy of GaAs on Silicon Substrate by a Shadow Mask Technique.** The First International Symposium on Laser and Optoelectronics Technology & Application (ISLOE). Singapore, 11-14 November, 1993.
2. **Cheewatas, P., Thainoi, S., Sopitpan, S., Ratanathamphan, S., and Panyakeow, S. Evaluation of Molecular Beam Epitaxy GaAs/GaAlAs by Photoluminescence Method.** The 20th Conference on Science and Technology of Thailand. 19-21 October, 1994.
3. **Sopitpan, S., Ratanathamphan, S., and Panyakeow, S. Photoluminescence of GaAs/GaAlAs Grown by Molecular Beam Epitaxy.** Proceeding of the 17th Conference on Electrical Engineering. King Mongkut Institute of Technology (North Bangkok), 1-2 December 1994.
4. **Cheewatas, P., Thainoi, S., Sopitpan, S., and Panyakeow, S. Study on Photoluminescence of GaAs/GaAlAs Multi-Quantum Well.** Proceeding of 21st Congress on Science and Technology of Thailand. Ambassador city Hotel, Cholburi, 25-27 October, 1995.
5. **Thainoi, S., Cheewatas, P., Sopitpan, S., Ratanathamphan, S., and Panyakeow, S. GaAs/GaAlAs Multi-Quantum Well Structure by Molecular Beam Epitaxy Technique.** Proceeding of 21st Congress on Science and Technology of Thailand. Ambassador city Hotel, Cholburi, 25-27 October, 1995.
6. **Sopitpan, S., Thainoi, S., Cheewatas, P., Ratanathamphan, S., Cholapranee, T., Sawadsaringkarn, M., and Panyakeow, S. Photoluminescence of GaAs/GaAlAs Multi-Quantum Well with Variable Well Widths.** Proceeding of the 18th Conference on Electrical Engineering : organized by Mahanakorn Technology University, Ambassador city Hotel, Cholburi, 22-24 November, 1995.

7. **Sopitpan, S., Cheewatas, P., Thainoi, S., Ratanathamphan, S., and Panyakeow, S. Photoluminescence Spectra of Shadow Masked Multiple Quantum Wells.** The 9th International Conference on Molecular Beam Epitaxy (MBE-IX), Pepperdine University, Malibu, California, USA. 5-9 August, 1996. (to be published in **Journal of Crystal Growth**)
8. **Sopitpan, S., Cheewatas, P., Thainoi, S., Ratanathamphan, S., and Panyakeow, S. Localized GaAs Compound Semiconductor Crystal Growth through Shadow Mask by Molecular Beam Epitaxy.** Proceedings of the 19th Conference on Electrical Engineering. Khon Kaen University, 7-8 November, 1996.
9. Pornpitakpong, K., **Sopitpan, S., Ratanathamphan, S., Cholapranee, T., and Panyakeow, S. The Study of GaAs Chemically-Etched Pattern.** Proceedings of the 19th Conference on Electrical Engineering. Khon Kaen University, 7-8 November, 1996.
10. Manmontri, U., **Sopitpan, S., Cheewatas, P., Thainoi, S., Ratanathamphan, S., and Panyakeow, S. Study on GaAs/GaAlAs MQW Structure for Photovoltaic Applications.** The Ninth International Photovoltaic Science and Engineering Conference (PVSEC-9). SEAGAIA Convention Complex, World Convention Center Summit, Miyazaki, Japan, 11-15 November, 1996. (to be published in **Solar Energy Materials and Solar Cells**)
11. Panyakeow, S., and **Sopitpan, S. Patternized Multi-Quantum Well Grown by Molecular Beam Epitaxy.** (invited). Regional Symposium on Materials Science : Fundamentals and Applications in Semiconductors and Superconductors. National Engineering Center, University of the Philippines, Diliman, Quezon City, Philippines, 10-12 December, 1996.



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Biography

Mr. Suwat Sopitpan was born on 4th October, 1962 at Suratthani. Received Bachelor Degree of Engineering (B.Eng.) in 1985 from Department of Electrical Engineering, Faculty of Engineering, Chiang Mai University, Chiang Mai. After working in a company as an engineer, he returned to study at Department of Electrical Engineering, Faculty of Engineering, Graduate School, Chulalongkorn University in 1988. Received Master Degree of Engineering (M.Eng.) in 1991. He went to conduct a part of his research at Universität der Bundeswehr München, Germany in 1993 and 1995 by DAAD scholarship.