在汐基板上研製砷化鎵太陽能電池

李岳穆、蕭宏彬

E-mail: 9608193@mail.dyu.edu.tw

摘 要

和矽太陽電池相比，在單晶砷化鎵基板上成長單接面（Single-junction）砷化鎵（GaAs）太陽能電池和多接面（Multi-junction）磷化銦鎵/砷化鎵（InGaP/GaAs）太陽能電池，在AM1.5下，效率分別可達到25.7%和29.5%。磷化銦鎵/砷化鎵/鍺（InGaP/GaAs/Ge）三接面太陽能電池效率更可達到40%。雖然如此，這些太陽能電池要應用於地表上的光電系統，成本仍需降低。而製造砷化鎵太陽能電池其成本來自於單晶砷 化鎵或鍺基板及需要利用磊晶技術。 本論文以便宜的材料矽做為基板。為了要在矽基板上成長砷化鎵太陽能電池，故將非晶鍺薄膜沉積在矽基板表面。然後藉著熱退火製程，使非晶鍺膜再結晶（Re-crystallized）。最後，將砷化鎵太陽能電池結構成長在具有多晶鍺膜的矽基板上。

關鍵詞 : 砷化鎵 ; 太陽能電池 ; 鍺 ; 再結晶

目錄

參考文獻

[1] H. J. Moller, " Semiconductors for Solar Cells, " Artech House Publishers, pp. 35-36(1993).

[2] 莊嘉琛, " 太陽能工程(太陽電池篇), " 全華科技圖書股份有限公司, pp. 135-137(2001).

[3] R. Venkatasubramanian, B. C. O ’ Quinn, E. Siivola, B.Keyes, and R. Ahrenkiel, " 20%(AM1.5) efficiency GaAs solar cells on sub-mm grain-size poly-Ge and its transition to low-cost substrates, " 26 th IEEE, PVSC. , pp. 811-814(1997).

[4] D. A. Neamen, " Semiconductor physics and devices, " McGraw Hill Higher Education, pp. 2-3(2003).

[5] M. Mauk, J. Balliet, and B. Feyock, " Recrystallized germanium on ceramic for III- V solar cell applications, " NCPV and Solar Program Review Meeting, pp. 207-201(2003).

[6] M. G. Mauk, J. R. Balliet, and B. W. Feyock, " Large-grain(>1-mm), recrystallized germanium films on alumina, fused silica, oxide-coated silicon substrates for III- V solar cell applications, " J. Crystal Growth, 250, pp. 50-56(2003).

[7] M. G. Mauk, J. Balliet, and B. W. Feyock, " Enabling technologies for making GaAs-based thin-film solar cells on ceramic and polysilicon substrates, " 29 th IEEE, PVSC. , pp. 1062-1065(2002).

[8] S. Min, " Semiconductor devices physics and technology, " Wiley, pp. 800(2003).

[9] M. K. Lee, R. H. Horng, D. S. Wuu and P. C. Chen, " Improvements in the heteroepitaxy of GaAs on Si by incorporating a ZnSe buffer layer, " International Electron Device meeting, pp. 331-334(1990).

[10] K. Eisenbeiser, R. Emrick, R. Droopad, Z.Yu, J. Finder, S. Rockwell, J. Holmes, C. Overgaard and W. Ooms, " GaAs MESFETs fabricated on Si substrates using a SrTiO3 buffer layer, " IEEE Electron Devices Lett. , 23, pp. 300-302(2002).

[11] G. Luo, T. H. Yang, E.Y. Chang, C.Y. Chang and K. A. Chao, " Growth of high-quality Ge epitaxial layers on Si (100), " Jpn. J. Appl. Phys. Lett. , 42, pp. 517-519(2003).
[12] 張景學,吳昌崙, " 半導體製造技術, " 文京圖書有限公司, pp. 152-154(2000).
[13] S. O. Kasap, " Optoelectronics and photonics principles and practices, " Prentice Hall, pp. 286-305(2003).
[14] J. Nelson, " The physics of solar cells, " Imperial College Press, pp. 191-192(2006).
[15] Z. Tan, S. M. Heald, M. Rapposch, C. E. Bouldin, and J. C. Woicik, " Gold-induced germanium crystallization, " Phys. Rev. , 46, pp. 9505-9510(1992).
[16] F. Katsuki, K. Hanafusa, and M. Yonemura, " Crystallization of amorphous germanium in Al/a-Ge bilayer film deposited on a SiO2 substrates, " J. Appl. Phys. , 89, pp. 4643-4647(2001).
[17] J. Derluyn, K. Dessein, G. Flamand, Y. Mols, J. Poortmans, G. Borghs and I. Moerman, " Comparison of MOVPE grown GaAs solar cells using different substrates and group-V precursors, " J. Crystal Growth, 247, pp. 237-244(2003).
[18] M. Yamaguchi, Y. Ohmachi, T. Oh ’ hara, Y. Kadota, M. Lmaizumi and S. Matsuda, " GaAs-on-Si solar cells for space use, " IEEE, pp. 1012-1015(2000).
[19] N. Gopalakrishnan, K. Baskar, H. Kawanami and I. Sakata, " Effect of low temperature grown buffer layer thickness on the growth of GaAs on Si by MBE, " J. Crystal Growth, 250, pp. 29-33(2003).