# CuPc/Alq3有機發光二極體之製作與光電特性之研究


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**摘 要**

本實驗主要以熱蒸鍍方式於已鍍有氧化銦錫 (Indium Tin Oxide, ITO) 之導電玻璃上，在壓力10?5 torr以下成長有機材料薄膜，用以製作有機發光二極體(Organic Light Emitting Devices, OLED)。所使用的材料為銅苯二甲藍(Copper Phthalocyanine, CuPc)與三(8-羥基??)鋁(Tris-(8-hydroxyquinoline) Aluminum, Alq3)，以CuPc/Alq3雙層為基礎結構，探討膜厚與發光特性之關係。 此外，有機發光二極體之效率與元件之電阻大小有很大的關係，所以本論文也測量不同金屬電極與氧化銦錫(Indium Tin Oxide, ITO)陽極間之接觸電阻值，並間接得知使用氧電漿(oxygen plasma)處理過後之氧化銦錫的功函數變化情形。 由量測的電流對電壓(I-V)特性曲線來看，當銅苯二甲藍(CuPc)厚度為300 ?，三(8-羥基??)鋁(Alq3)厚度為400 ?與600 ?時的底限電壓較小，約5 V~ 6 V左右。 氧化銦錫與金的接觸電阻率比較小，經過氧電漿處理過的氧化銦錫與金接觸電阻率更低，顯然金是比較適合做連接氧化銦錫的電極。



關鍵詞 : 有機發光二極體 ; 銅苯二甲藍(CuPc) ; 三(8-羥基??)鋁(Alq3)


**目錄**



**參考文獻**


[1] M. Pope, H. Kallmann, P. Magnante, “ Electroluminescence in Organic Crystals, ” J. Chem. Phys., Vol. 38, pp. 2042-2043, April 1963.

[2] W. Helfrich and W. G. Schneider, “ Recombination Radiation in Anthracene Crystals ”, Phys. Rev. Lett., vol. 14, pp. 229-231, Feb. 1965.

[3] P. S. Vincett, W. A. Barlow, R. A. Hann, and G. G. Roberts, “ Electrical Conduction and Low Voltage Blue Electroluminescence in Vacuum-Deposited Organic Films, ” Thin Solid Films, vol. 94, pp. 171-183, Aug. 1982.

[4] G. G. Roberts, M. McGinnity, W. A. Barlow and P. S. Vincett, “ Electroluminescence, photoluminescence and electroabsorption of a lightly substituted anthracene langmuir film, ” Solid State Commun., vol. 32, pp. 683-686, Nov. 1979.

[5] R. H. Partridge, “ Electro-luminescence from polyvinylcarbazole films, ” Polymer, vol. 24, pp. 733-738, June 1983.

[6] C. W. Tang and S. A. VanSlyke, “ Organic electroluminescent diodes, ” Appl. Phys. Lett., vol. 51, pp. 913-915, Sept. 1987.

[7] C. W. Tang, S. A. Vanslyke and C. H. Chen, “ Electroluminescence of Doped Organic Thin Films, ” J. Appl. Phys., vol. 65, pp. 3610-3616, May 1989.
[8] J. H. Burroughes, D. D. C. Bradley, A. R. Brown, R. N. Marks, K. MacKay, R. H. Friend, P. L. Burn, and A. B. Holmes, “ Light emission from poly(p-phenylene vinylene): A comparison between photo- and electro-luminescence, ” Synthetic Metals, vol. 43, pp. 3135-3141, June 1991.
[9] M. A. Baldo, D. F. O ’ Brien, M. E. Thompson, and S. R. Forrest, “ Excitonic singlet-triplet ratio in a semiconducting organic thin film, ” Phys. Rev. B, vol. 60, pp. 14422 – 14428, Nov. 1999.
[10] M. A. Baldo, M. E. Thompson, and S. R. Forrest, “ High-efficiency fluorescent organic light-emitting devices using a phosphorescent sensitizer, ” Nature, vol.403, pp. 750-753, Feb. 2000.
[11] C. W. Tang and S. A. VanSlyke, “ Organic electroluminescent diodes, ” Appl. Phys. Lett., vol. 51, pp. 913-915, Sept. 1987.
[12] C. Adachi, S. Tokito, T. Tsutsui, and S. Saito, “ Electroluminescence in Organic Films with Three-Layer Structure, ” Jpn. J. Appl. Phys. Vol. 27, L269-L271, Feb. 1988.
[13] C. Adachi, S. Tokito, T. Tsutsui, and S. Saito, “ Organic Electroluminescent Device with a Three-Layer Structure, ” Jpn. J. Appl. Phys., vol. 27, L713-L715, April 1988.
[14] C. Adachi, S. Tokito, T. Tsutsui, and S. Saito, “ Confinement of charge carriers and molecular excitons within 5-nm-thick emitter layer in organic electroluminescent devices with a double heterostructure, ” Appl. Phys. Lett., vol. 57, pp. 531-533, Aug. 1990.
[15] Y. Ohmori, A. Fujii, M. Uhida, C. Morishima, and K. Yoshino, “ Observation of spectral narrowing and emission energy shift in organic electroluminescent diode utilizing 8-hydroxyquinoline aluminum/aromatic diamine multilayer structure, ” Appl. Phys.Lett., vol. 63, pp. 1871-1873, Oct. 1993.
[16] F. S. Hung, C. W. Tang, and M. G. Mason, “ Enhanced electron injection in organic electroluminescence devices using an Al/LiF electrode, ” Appl. Phys. Lett., vol. 70, pp. 152-154, Jan. 1997.
[17] H. G. E. Jabbour, Y. Kawabe, S. E. Shaheen, M. M. Morrell, J. F. Wang, B. Kippelen, and N. Peyghambarian, “ Highly efficient and bright organic electroluminescent devices with an aluminum cathode, ” Appl. Phys. Lett., vol.71, pp. 1762-1764, Sept. 1997.
[18] T. Wakimoto, Y. Fukuda, K. Nagayama, A. Yokoi, H. Nakada, and M. Tsuchida, “ Organic EL cells using alkaline metal compounds as electron injection materials, ” IEEE Trans. Electron Devices, vol. 44, pp. 1245-1248, Aug. 1997.
[19] G. E. Jabbour, B. Kippeien, N. R. Armstrong, and N. Peyhambarian, “ Aluminumbased cathode structure for enhanced electron injection in electroluminescent organic devices, ” Appl. Phys. Lett., vol.73, pp. 1185-1187, Aug. 1998.
[21] K. Yamashita, T.. Mori, T. Mizutani, H. Miyazaki, and T. Takeda, “ EL properties of organic light-emitting-diode using TPD derivatives with diphenylstylyl groups as hole transport layer, ” Thin Solid Films, vol. 363, pp. 33-36, March 2000.
[22] C. Adachi, K. Nagai, and N. Tamoto, “ Molecular design of hole transport materials for obtaining high durability in organic electroluminescent diodes, ” Appl. Phys. Lett., vol.66, pp. 2679-2681, May 1995 [23] Y. Shirata, Y. Kuwabara, D. Okuda, R. Okuda, H. Ogawa, H. Inada, T. Wakimoto, H. Nakada, Y. Yonemoto, S. Kawami, and K. Imai, “ Starburst molecules based on ?-electron systems as materials for organic electroluminescent devices, ” J. Lumin., vol.72-74, pp. 985-991, June 1997.
[24] Y. Shirota, K. Okumoto, and H. Inada, “ Thermally stable organic light-emitting diodes using new families of hole-transporting amorphous molecular materials, ” Synth. Met., vol. 111-112, pp. 387-391, June 2000.
[25] J. Kido and Y. Iizumi, “ Efficient electroluminescence from tris(4-methyl-8-quinolinolato)aluminum(III), ” Chem. Lett., vol.26, pp. 963-964, Oct. 1997.
[26] H. Murata, Z. H. Kafafi, and M. Uchida, “ Efficient organic light-emitting diodes with undoped active layers based on silole derivatives, ” Appl. Phys. Lett., vol. 80, pp. 189-191, Jan. 2002.
[27] C. H. Chen and C. W. Tang, in Chemistry of Functional Dyes, vol. 2, Proceedings of the Second International Symposium on Chemistry of Functional Dyes, 1993, pp. 536.
[28] J. Littman and P. Martic, “ Efficient organic electroluminescent device using a single bipolar carrier transport layer, ” J. Appl. Phys., vol. 72, pp. 1957-1960, Sept. 1992.
[29] Dieter K. Schroder, Semiconductor Material and Device Characterization, 3rd ed.Hoboken, NJ: John Wiley & Sons, 2006, pp. 138-149.
[30] H. Aziz, Z. D. Popovic, N.-X. Hu, A.-M. Hor, and G. Xu, “ Degradation Mechanism of Small Molecule-Based Organic Light-Emitting Devices, ” Science , vol. 283, pp. 1900-1902, March 1999.
[31] Z. Y. Xie, L. S. Hung, and S. T. Lee, “ High-efficiency red electroluminescence from a narrow recombination zone confined by an organic double heterostructure, ” Appl. Phys. Lett., vol. 79, pp. 1048-1050, August 2001.