可撓式COC材料薄板之力學分析

管衍溢、林見昌

E-mail: 9701478@mail.dyu.edu.tw

摘 要

COC(Cyclic Olefin Copolymer)材料有低透水性、高透光度等較其他高分子材料所不及之優點，本文針對其應用在可撓式基板上之力學行為，分別以實驗量測及理論分析進行研究。在實驗量測部分，先將COC顆粒製作成透明薄板後使用儀器量測光學特性，然後進行往復彎曲實驗，觀察其表面受到往復壓縮後所產生之皺折紋理及受到往復拉伸後產生之破裂紋理情形。在理論分析部分，分成單層COC材料薄板及ITO/COC複合薄板進行理論分析，利用ANSYS有限元軟體，分別以2D及3D模式進行數值模擬，分析其產生之撓曲位移、應變、應力等力學行為。針對量測實驗和理論分析結果加以討論，並獲得一些在應用上可供參考的結論。

關鍵詞 : 有限元素 ; COC ; 塑膠基板 ; 薄板 ; 撓曲 ; 複合材料層板 ; 應力 ; 應變

目錄

參考文獻

[1] 田宏隆，“平面顯示器用可撓式塑膠基材技術與應用”，工業材料雜誌光電特刊，第195期，第156頁，2003。

[2] H. H. Yu, S. J. Hwang and K. C. Hwang,“Preparation and characterization of a novel flexible substrate for OLED.”Vol.248, p.51, 2005 [3] H. H. Yu, S. J. Hwang, M. C. Tseng and C. C. Tseng,“The effect of ITO films thickness on the properties of flexible organic light emitting diode.”Vol.259, p.187, 2006 [4] S. J. Hwang and H. H. Yu,“Study of the Novel Polymer COC Waveguide Film.”Jap. J. Appl. Phys., Vol.44 (4B) , p.2541, 2005 [5] E. Schwartz,“Roll to Roll Processing for Flexible Electronics”. Cornell University MSE 542: Flexible Electronics Prof. Chris Ober, 2006 [6] Z. Chen, B. Cotterellb, W. Wang, E. Guentherb, S-J. Chua,“A Mechanical Assessment of Flexible Optoelectronic Devices”Thin Solid Films, Vol.394, p.202, 2001 [7] H. Gleskova, I-C. Cheng, S. Wagner, J. C. Sturm, and Z. Suo,“Mechanics of Thin-Film Transistors and Solar Cells on Flexible Substrates.”Solar Energy, Vol.80, p.687, 2006 [8] N.E. Jansson, Y. Leterrier, J.-A.E. Manson*,“Modeling of multiple cracking and decohesion of a thin film on a polymer substrate,“Engineering Fracture Mechanics, Vol.73, p.2614, 2006 [9] S. Wagner, I-C. Cheng, K. Long, A. Kattamis, J-C. Sturm,”Managing Mechanical Stress in Flexible Active-Matrix Backplanes,”IDMC, 2005 [10] Y. Leterrier, C. Fischer1, L. Me'dico, F. Demarco, J.-A. E. Ma*nson, P. Bouten, J. DeGoede, J.A. Nairn,“Mechanical properties of transparent functional thin films for flexible displays,”46th Annual Technical Conference Proceedings, Vol.505, p.856, 2003 [11] Y. Leterrier, P. Bouten, X. Jiang,“Layer mechanics, Experimental methods and models.”Deliverable D4PU, FLEXled-epfl-0209-002, 2002 [12] D-H. Kim, H-K. Yoon, D-H. Shin, R. Murakami,“Mechanical properties of ITO/PET Thin Film Deposited by DC MG Method.“2005 International Symposium on Electronics Materials and Packaging (EMAP2005), 2005 [13] 姚寶順,“氧化銦錫薄膜之電磁屏蔽效能和其機械性質之研究.”國立成功大學 材料科學及工程學系, 87年 6月 [14] K. Ro"ll, "Analysis of Stress and Strain DistributioninThin Films and Substrates", J. Appl.

Phys., Vol.47,p.3224, 1976 [15] P.C.P. Bouten, "Failure Test For Brittle Conductive Layers On Flexible Display Substrates", Proc. Eurodisplays, Nice (F), p.313, 2002 [16] P.C. P. Bouten, P.J. Slikkerveer, Y. Leterrier, “ Mechanics of ITO on Plastic Substrates for Flexible Displays ”, Flexible Flat Panel Displays, 2005 [17] L.B. Freund, “ Some elementary connections between curvature and mismatch strain in compositionally graded thin films. ” J. Mech. Phys. Solids, Vol.44, P.723, 1996.
[18] S.-R. Kim, J.A. Nairn, "Fracture Mechanics Analysis of Coating/Substrate Systems: I. Analysis of Tensile and Bending Experiments", Eng. Fract. Mech., Vol.65, p.573, 2000 [19] T. Li, Z. Suo*, “ Deformability of Thin Metal Films on Elastomer Substrates ”, International Journal of Solids and Structures, Vol.43, p.2351, 2006 [20] Y. Xiang , T. Li, Z. Suo, J.J. Vlassak, “ High Ductility of a Metal Film Adherent on a Polymer Substrate. ” Appl. Phys. Lett., 2005.
[21] Y. Xiang, X. Chen, J.J. Vlassak, “ The Mechanical Properties of Electroplated Cu Thin-Films Measured by Means of the Bulge Test Techniques. ” Mater. Res. Soc. Symp. Proc. 695, L4.9. 2002.
[22] F. Macionczyk, W. Bruckner, “ Tensile Testing of AlCu Thin Films on Polyimide Foils. ” J. Appl. Phys, Vol.86, p.4922, 1999.
[23] T. Li, Z.Y. Huang, S.P. Lacour, S. Wagner, Z. Suo, “ Stretchability of Thin Metal Films on Elastomer Substrates. ” Appl. Phys. Lett, Vol.85, p.3435, 2004 [24] T. Li, Z.Y. Huang, Z.C. Xi, S.P. Lacour, S. Wagner, Z. Suo, “ Delocalizing Strain in a Thin Metal Film on a Polymer Substrate. ” Mech. Mater, Vol.37, p.261, 2005 [25] ANSYS User ’ s Guide release 11.0 [26] C.L. DYM, I.H. Shames, “ Solid Mechanics: A Variational approach, ” Mc Graw - Hill, Inc., p.446, 1973