

Enhancement of current-voltage characteristics of multilayer organic light emitting diodes by using nanostructured composite films

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Abstract: With the aim of improving the photonic efficiency of an organic light emitting diode (OLED) and its display duration, both the hole transport layer (HTL) and the emitting layer (EL) were prepared as nanostructured thin films. For the HTL, nanocomposite films were prepared by spin-coating a homogeneous solution of low molecular weight poly(4-styrenesulfonate) (PEDOT-PSS) and surfactant-capped TiO₂ nanocrystals onto low resistivity indium tin oxide (ITO) substrates; for the EL, nanocrystalline titanium oxide (nc-TiO₂)-embedded Poly[2-methoxy-5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene] (MEH-PPV+ nc-TiO₂) conjugate polymers were spin-coated onto the HTL. Also, for a shallow contact of Al/LiF/MEH-PPV instead of Al/MEH-PPV a super LiF thin film was deposited onto the EL by vacuum evaporation. The resulting multilayer OLED had the following structure of Al/LiF/MEH-PPV+ nc-TiO₂ /PEDOT-PSS+ nc-TiO₂ /ITO. Characterization of the nanocomposite films showed that both the current-voltage (I-V) characteristics and the photoluminescent properties of the nanocomposite materials were significantly enhanced in comparison with the standard polymers. OLEDs made from these layers would exhibit a large photonic efficiency. © 2009 American Institute of Physics.

Index Keywords: Conjugate polymers; Emitting layer; Hole transport layers; Homogeneous solutions; Indium tin oxide substrates; Low molecular weight; Low resistivity; MEH-PPV; Methoxy; Multilayer organic light emitting diodes; Nanocomposite film; Nanocomposite materials; Nanostructured composites; Nanostructured thin film; PEDOT-PSS; Photo-luminescent properties; Photonic efficiencies; Poly(4-styrenesulfonate); TiO₂ nanocrystals; Composite films; Current voltage characteristics; Electroluminescence; Film preparation; Helmet mounted displays; Lanthanum compounds; Light emission; Light emitting diodes; Light sources; Multilayer films; Multilayers; Nanocomposites; Oxide films; Physical optics; Plastic coatings; Spin dynamics; Surface active agents; Tin; Vacuum evaporation; Water analysis; Organic light emitting diodes (OLED)

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References:

- Salafsky, J.S., (1999) Phys. Rev. B, 59, p. 10885. , 0163-1829,. 10.1103/PhysRevB.59.10885
- Burlakov, V.M., Kawata, K., Assender, H.E., Briggs, G.A.D., Ruseckas, A., Samuel, I.D.W., (2005) Phys. Rev. B, 72, p. 075206. , 0163-1829,. 10.1103/PhysRevB.72.075206
- Petrella, A., Tamborra, M., Cozzoli, P.D., Curri, M.L., Striccoli, M., Cosma, P., Farinola, G.M., Agostiano, A., (2004) Thin Solid Films, 451-452, p. 64. , 0040-6090,. 10.1016/j.tsf.2003.10.106
- Kawata, K., Burlakov, V.M., Carey, M.J., Assender, H.E., Briggs, G.A.D., Ruseckas, A., Samuel, I.D.W., (2005) Sol. Energy Mater. Sol. Cells, 87, p. 715. , 0927-0248,. 10.1016/j.solmat.2004.07.046
- Carter, S.A., Scott, J.C., Brock, P.J., (1997) Appl. Phys. Lett., 71, p. 1145. , 0003-6951,. 10.1063/1.119848
- Tasch, S., Leising, G., Scherf, U., (1996) Appl. Phys. Lett., 68, p. 1090. , 0003-6951,. 10.1063/1.115722
- Oey, C.C., Djurixic, A.B., Kwong, C.Y., Cheung, C.H., Chan, W.K., Nunzi, J.M., Chui, P.C., (2005) Thin Solid Films, 492, p. 253. , 0040-6090,. 10.1016/j.tsf.2005.07.118
- Choulis, S.A., Mathai, M.K., Choong, V.-E., (2006) Appl. Phys. Lett., 88, p. 213503. , 0003-6951,. 10.1063/1.2200285
- Yusuf, M.M., Imai, H., Hirashima, H., (2002) J. Sol-Gel Sci. Technol., 25, p. 65. , 0928-0707,. 10.1023/A:1016045111857
- Dinh, N.N., Chi, L.H., Thuy, T.T.C., Thanh, D.V., Nguyen, T.P., (2008) J. Korean Phys. Soc., 53, p. 802. , 0374-4884
- Yang, S.H., Nguyen, T.P., Le Rendu, P., Hsu, C.S., (2005) Composites, Part A, 36, p. 509. , 1359-835X,. 10.1016/j.compositesa.2004.10.008
- Heliotis, G., Itskos, G., Murray, R., Dawson, M.D., Watson, I.M., Bradley, D.D.C., (2006) Adv. Mater. (Weinheim, Ger.), 18, p. 334. , 0935-9648,. 10.1002/adma.200501949
- Carter, S.A., Scott, J.C., Brock, J., (1997) J. Appl. Phys., 71, p. 1145. , 0021-8979
- Quyang, J., Xu, Q., Chu, C.-W., Yang, Y., Li, G., Shinar, J., (2004) Polymer, 45, p. 8443. , 0032-3861,. 10.1016/j.polymer.2004.10.001
- Tehrani, P., Kanciurzevska, A., Crispin, X., Robinson, N.D., Fahlman, M., Berggren, M., (2007) Solid State Ionics, 177, p. 3521. , 0167-2738,. 10.1016/j.ssi.2006.10.008
- Quyang, J., Chu, C.-W., Chen, F.-C., Xu, Q., Yang, Y., (2005) Adv. Funct. Mater., 15, p. 203. , 1616-301X,. 10.1002/adfm.200400016
- Scott, J.C., Kaufman, J., Brock, P.J., Dipietro, R., Salem, J., Goitia, J.A., (1996) J. Appl. Phys., 79, p. 2745. , 0021-8979,.

10.1063/1.361096

- Chung Thuy, T.T., Chi, L.H., Dinh, N.N., (2009) J. Korean Phys. Soc., 54, p. 291. , 0374-4884
- Tsutsui, T., Saito, S., (1993) NATO ASI Ser., Ser. e, 246, p. 123. , 0168-132X