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发光学应用及交叉前沿

不同表面修饰制备高性能柔性薄膜晶体管

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摘要： 分别采用六甲基二硅胺(HMDS,Hexamethyldisilazane)和聚苯乙烯/氯硅烷复合材料修饰聚乙烯基苯酚(PVP)绝缘层制备了底接触的有机薄膜晶体管并研究了其半导体层的表面形貌和器件的电学性能。原子力显微镜观察发现,并五苯半导体薄膜在不同的界面修饰上的生长形貌产生了很大变化。在PVP上沉积的并五苯晶粒尺寸都小于150 nm,经过聚苯乙烯/氯硅烷复合材料和HMDS处理后的PVP表面生长的并五苯晶粒尺寸则分别在200~400 nm和400~600 nm。大尺寸的晶粒能够减小器件沟道内的陷阱浓度,从而有效地提高电学性能。PVP绝缘层采用聚苯乙烯/氯硅烷和HMDS修饰后,与未修饰的器件相比迁移率分别提高了58倍和82倍。采用HMDS作为表面修饰层制备柔性OTFT,并五苯场效应晶体管的关态电流约为10^{-9}A, 电流的开关比超过10^4,最大场效应迁移率约可达0.338 $cm^2 \cdot V^{-1} \cdot s^{-1}$.

关键词： 并五苯 聚乙烯基苯酚(PVP) 聚苯乙烯(PS) 偏压应力 柔性有机薄膜晶体管

本刊中的类似文章

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Preparation of High-performance Flexible Organic Thin-film Transistor Through Different Dielectric Surface Modification

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Abstract: High-performance pentacene organic thin film transistor (OTFT) on the Poly(4-vinylphenol) (PVP) dielectric layers with different modification layers using hexamethyldisilazane (HMDS) and polystyrene/chlorosilane composite has been developed. The effect of the different modification layers on the growth mode of pentacene films and the performance of the OTFT were investigated. The AFM images showed that the morphology of pentacene semiconductor films were affected by the interface modification. The pentacene grains grown on the HMDS modified PVP substrates were in the range of 400~600 nm which were larger than those grown on the polystyrene/chlorosilane and bare PVP substrates with dimension in the range of 200~400 nm and 150 nm, respectively. Large particle size can reduce charge trapping and improve the electrical performance. The field-effect mobility of the polystyrene/chlorosilane modified PVP and the HMDS modified PVP was 58 times and 82 times higher than the bare PVP layers. The flexible device with HMDS modification had a maximum field-effect mobility of up to 0.338 $cm^2 \cdot V^{-1} \cdot s^{-1}$. The transfer curve showed an on/off current ratio exceeding 10^4 with the off-current of about 10^{-9} A.

Keywords: pentacene PVP PS bias-stress effect flexible organic thin-film transistor

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参考文献:

[1] Crone B, Dodabalapur A, Lin Y Y, *et al.* Large-scale complementary integrated circuits based on organic transistors [J]. *Nature,* 2000, 403(6769):521-523.

[2] Zhang H, Zhang L, Li J, *et al.* Improvement of ZnO-TFT performance by annealing ZnO Film [J]. *Chin. J. Lumin.*(发光学报.2011, 32(12):1281-1285

[3] Sekitani T, Noguchi Y, Hata K, *et al.* A rubberlike stretchable active matrix using elastic conductors [J]. *Science,* 2008, 321(5895):1468-1472.

[4] DeLongchamp D M, Kline R J, Lin E K, *et al.* High carrier mobility polythiophene thin films: Structure determination by experiment and theory [J]. *Adv. Mater.,* 2007, 19(6):833-837.

[5] Yan H, Chen Z H, Zheng Y, *et al.* A high-mobility electron-transporting polymer for printed transistors [J]. *Nature,* 2009, 457(7230):679-686.

[6] Cho J H, Lee J, Xia Y, *et al.* Printable ion-gel gate dielectrics for low-voltage polymer thin-film transistors on plastic [J]. *Nat. Mater.,* 2008, 7(11):900-906.

[7] Tsao H N, Cho D M, Park I, *et al.* Ultrahigh mobility in polymer field-effect transistors by design [J]. *J. Am. Chem. Soc.,* 2011, 133(8):2605-2612.

[8] Sun X N, Di C A, Liu Y Q. Engineering of the dielectric-semiconductor interface in organic field-effect transistors [J]. *J. Mater. Chem.,*

[9] Jiao Y, Zhang X A, Zhai J X, *et al.* Effect of channel layer thickness on the device characteristics of room temperature fabricated In_2O_3 thin-film transistors [J]. *Chin. J. Lumin.*(发光学报.2013, 34(3):324-328

[10] Lin Y Y, Gundlach D J, Nelson S F, *et al.* Stacked pentacene layer organic thin-film transistors with improved characteristics [J]. *IEEE. Elect. Device Lett.,* 1997, 18(12):606-608

[11] Klauk H, Halik M, Zschieschang U, *et al.* High-mobility polymer gate dielectric pentacene thin film transistors [J]. *J. Appl. Phys.,* 2002, 92(9):5259-5263.

[12] Kato Y, Iba S, Teramoto R, *et al.* High mobility of pentacene field-effect transistors with polyimide gate dielectric layers [J]. *Appl. Phys. Lett.,* 2004, 84(19):3789-3791.

[13] Yoneya N, Noda M, Hirai N, *et al.* Reduction of contact resistance in pentacene thin-film transistors by direct carrier injection into a-few-molecular-layer channel [J]. *Appl. Phys. Lett.,* 2004, 85(20):4663-4665.

[14] Yang H C, Shin T J, Ling M M, *et al.* Conducting AFM and 2D GIXD studies on pentacene thin films [J]. *J. Am. Chem. Soc.,* 2005, 127(33):11542-11543.

[15] Yoon M H, Yan H, Facchetti A, *et al.* Low-voltage organic field-effect transistors and inverters enabled by ultrathin cross-linked polymers as gate dielectrics [J]. *J. Am. Chem. Soc.,* 2005, 127(29):10388-10395.

[16] Yang S Y, Shin K, Park C E. The effect of gate-dielectric surface energy on pentacene morphology and organic field-effect transistor characteristics [J]. *Adv. Funct. Mater.,* 2005, 15(11):1806-1814.

[17] Min H G, Seo E, Lee J, *et al.* Behavior of pentacene molecules deposited onto roughness-controlled polymer dielectrics films and its effect on FET performance [J]. *Synth. Met.,*

[18] Walter S R, Youn J, Emery J D, *et al.* In-situ probe of gate dielectric-semiconductor interfacial order in organic transistors: Origin and control of large performance sensitivities [J]. *J. Am. Chem. Soc.,* 2012, 134 (28):11726-11733.

[19] Choi D, Ahn B, Kim S H, *et al.* High-performance triisopropylsilethynyl pentacene transistors *via* spin coating with a crystallization-assisting layer [J]. *ACS Appl. Mater. Interf.,* 2012, 4(1):117-122.

[20] Choi H H, Lee W H, Cho K. Bias-stress-induced charge trapping at polymer chain ends of polymer gate-dielectrics in organic transistors [J]. *Adv. Funct. Mater.,* 2012, 22(22):4833-4839.