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论文

聚(2-甲氧基-5-辛氧基)对苯乙炔/单壁碳纳米管复合材料的光物理性能研究

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摘要:

采用原位脱氯化氢缩合聚合法制备了聚(2-甲氧基-5-辛氧基)对苯乙炔/单壁碳纳米管(PMOCOPV/SWNTs)复合材料. 红外光谱和拉曼光谱证实了在SWNTs表面的包覆层为PMOCOPV. 高分辨透射电子显微镜观察发现, PMOCOPV/SWNTs复合材料直径为4~7 nm, 其中PMOCOPV包覆层厚度约为2~5 nm. 紫外-可见吸收光谱表明, 随着SWNTs含量的增加, PMOCOPV/SWNTs的吸收发生蓝移且强度提高. 荧光光谱研究表明, 随着SWNTs含量的增加, PMOCOPV/SWNTs的最大发射波长发生蓝移且强度减小, SWNTs与PMOCOPV之间形成了光致电子转移体系, 使π电子离域程度增加, 导致荧光量子效率降低. 根据E_g与入射光子能量$h\nu$的关系, 拟合了PMOCOPV/SWNTs薄膜的光学禁带宽度, 发现随着SWNTs含量的增加, E_g逐渐减小. 采用简并四波混频方法测试其三阶非线性极化率$\chi^{(3)}$, 结果表明, 随着SWNTs含量的增加, PMOCOPV/SWNTs复合体的非线性光学响应逐渐增强, 说明PMOCOPV与SWNTs之间形成了分子间光致电子转移体系, 产生了复杂的分子间π-π电子非线性运动.

关键词: 聚(2-甲氧基-5-辛氧基)对苯乙炔; 单壁碳纳米管; 复合材料; 光物理性能; 光致电子转移

Photophysical Properties of Poly(2-methoxy-5-octyloxy)-*p*-phenylene Vinylene/SWNTs Composites

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Abstract:

The photoelectric composites of poly(2-methoxy-5-octyloxy)-*p*-phenylene vinylene/single-walled carbon nanotubes(PMOCOPV/SWNTs) were prepared by dehydrochlorination *in-situ* polymerization. The results of Fourier transform infrared spectroscopy and Raman spectroscopy indicate that PMOCOPV is coated on the surface of SWNTs. The composite dimensions were observed by highly resolution transmission electron microscope, the diameter of PMOCOPV/SWNTs is about 4—7 nm and the thickness of the coated PMOCOPV is about 2—5 nm. The absorption of PMOCOPV/SWNTs is strengthened with the contents of SWNTs increasing, and a blue shift of the absorption peak can be clearly observed in the UV-Vis spectrum. Photoluminescence spectroscopy indicates that the maximum emission wavelength of the PMOCOPV/SWNTs is blue-shifted and intensity of photoluminescence decreases with increasing SWNTs concentration. PMOCOPV/SWNTs shows fluorescence quenching, which involved the inter-molecular photo-induced charge transfer process. The optical band gap of PMOCOPV/SWNTs decreases gradually with the contents of SWNTs increasing. Third-order optical nonlinear susceptibility of PMOCOPV/SWNTs composites was measured by degenerate four wave mixing. The results show that the third-order nonlinear optical responses of PMOCOPV/SWNTs composites are enhanced gradually when SWNTs content increased, which can be attributed to inter-molecular photo-induced electron transfer and *π-π* electron coupling between PMOCOPV and SWNTs.

Keywords: Poly(2-methoxy-5-octyloxy)-*p*-phenylene vinylene; Single walled carbon nanotubes (SWNTs); Composite; Photophysical property; Photo-induced electron transfer

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参考文献:

[1]Kobayashi T., Mito A., Kobayashi S., et al.. Chem. Phys. Lett.
[J], 2007, 433(4—6): 379—384

[2]Sato T., Kishida H., Nakamura A., et al.. Synth. Met.
[J], 2007, 157(6/7): 318—322

[3]Iijima S.. Nature
[J], 1991, 354(6348): 56

[4]Grujicic M., Sun Y. P., Koudela K. L.. Appl. Surf. Sci.
[J], 2007, 253(6): 3009—3021

[5]Jeykumari D. R. S., Ramaprabhu S., Narayanan S. S.. Carbon
[J], 2007, 45(6): 1340—1353

[6]Margulis Vl. A., Boyarkina O. V., Gaiduk E. A.. Opt. Commun.
[J], 2005, 249(1—3): 339—349

[7]Margulis Vl. A., Gaiduk E. A., Zhidkin E. N., et al.. Mater.
[J], 1999, 8(7): 1240—1245

[8]Margulis Vl. A., Sizikova T. A.. Phys. B: Conden. Mat.
[J], 1998, 245(2): 173—189

[9]Curran S., Davey A. P., Coleman J., et al.. Synth. Met.
[J], 1999, 103(1—3): 2559—2562

[10]Margulis Vl. A., Muryumin E. E.. Phys. B: Conden. Mat.
[J], 2007, 390(1/2): 134—142

[11]Umeyama T., Kadota N., Tezuka N., et al.. Chemical Physics Letters
[J], 2007, 444(4—6): 263—267

[12]Sariciftci N. S., Smilowitz L., Heeger A. J., et al.. Science
[J], 1992, 258: 1474

[13]O'Flaherty S. M., Hold S. V., Brennan M. E., et al.. J. Opt. Soc. Am. B: Opt. Phys.
[J], 2003, 20(1): 49—58

[14]Chen Y. C., Raravikar N. R., Schadler L. S., et al.. Appl. Phys. Lett.
[J], 2002, 81(6): 975

[15]Tang B. H., Xu H. Y.. Macromolecules
[J], 1999, 32(8): 2569—2576

[16]ZHOU Hong(周虹), SUN Chang-Qing(孙长青). Chem. J. Chinese Universities(高等学校化学学报)
[J], 2008, 29(11): 2159—2163

[17]DU Zhuo(杜卓), ZHANG Na(张娜), WANG Jian-Hua(王建华). Chem. J. Chinese Universities(高等学校化学学报)
[J], 2008, 29(5): 902—905

[18]Panhuis M. I. H., McCarthy B., Coleman J. N., et al.. J. Phys. Chem. B
[J], 2002, 106(9): 2210—2216

[19]YUAN Ren-Kuan(袁仁宽), KONG Fan(孔凡), OU Chang-Gang(欧昌刚), et al.. Chinese J. Lumin.(发光学

报)
[J], 2005, 26(5): 655—658

[20]Curran S. A., Ajayan P. M., Blau W. J., et al.. Adv. Mater.
[J], 1998, 10(14): 1091—1093

[21]Sonntag L. P., Spitler M. L.. Phys.Chem.
[J], 1985, 89: 1453

[22]TANG Ai-Wei(唐爱伟), TENG Feng(滕枫), GAO Yin-Hao(高银浩), et al.. Spectrosc. Spect. Anal.(光谱学与光谱分析)
[J], 2006, 26(12): 2169—2172

[23]Kamalasanan M. N., Chandra S.. Appl. Phys. Lett.
[J], 1991, 59(27): 3547—3549

[24]Morita S., Zakhidov A. A., Yoshino K.. Solid State Commun.
[J], 1992, 82(4): 249—252

[25]O'Flaherty S. M., Murphy R., Hold S. V., et al.. J. Phys. Chem. B
[J], 2003, 107(4): 958—964

[26]FENG Wei(封伟), YI Wen-Hui(易文辉), FENG Yi-Yu(冯奕钰), et al.. Acta Phys. Sin.(物理学报)
[J], 2006, 55(7): 3772—3777

[27]Sauteret C., Hermann J. P., Frey R.. Phys. Rev. Lett.
[J], 1976, 36(16): 956—959

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