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材料合成及性能

SiO_2包覆共轭聚合物CN-PPV纳米探针的制备与荧光性质

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摘要： 采用纳米沉淀法制备了半导体聚合物CN-PPV纳米粒子,并用改进的Stöber方法对纳米粒子进行包覆,获得了发光稳定的SiO_2/CN-PPV纳米粒子。用动态光散射(DLS)及透射电镜(TEM)方法对粒子尺寸进行了表征,结果表明包覆前的CN-PPV纳米粒子平均粒径约为30 nm,包覆获得SiO_2/CN-PPV纳米粒子的平均粒径约为60 nm。通过紫外-可见吸收光谱及荧光光谱对包覆前后纳米粒子的发光性质进行了比较,发现共轭聚合物CN-PPV包覆后的发射光谱与包覆前相比发生了小的蓝移,表明共轭聚合物的分子构型可能发生了微小变化。SiO_2包覆可以提高聚合物发光分子的光稳定性,并且提供用于生物分子耦联的表面,这类材料有望在生物医学成像中获得应用。

关键词： 共轭聚合物 纳米粒子 CN-PPV 二氧化硅 荧光性质

Preparation and Fluorescence Properties of Silica Encapsulated CN-PPV Nanoparticles

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Abstract: Semiconducting polymer CN-PPV nanoparticles (NPs) were prepared by the reprecipitation method and further encapsulated by a facile method. The particle size and the distribution were characterized by dynamic light scattering (DLS) and transmission electron microscopy (TEM). The average diameter is ~30 nm for bare CN-PPV nanopartilces and ~60 nm for encapsulated ones. UV-Vis and fluorescence spectroscopy showed consistent results between CN-PPV and SiO_2/CN-PPV nanoparticles. More importantly, silica capsulation improved the photostablility of CN-PPV nanoparticles, and provided reliable surface for covalent conjugation with biomolecules. These photostable nanoprobes are promising for biomedical imaging applications.

Keywords: conjugated polymer nanoparticles encapsulation silica fluorescence
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参考文献：

[1] Jaiswal J K, Mattoussi H, Mauro J M, *et al.* Long-term multiple color imaging of live cells using quantum dot bioconjugates[J]. *Nat. Biotechnol.,* 2003, 21(1):47-51.

[2] Alivisatos A P. The use of nanocrystals in biological detection[J]. *Nat. Biotechnol.,* 2004, 22(1):47-52.

[3] Medintz I L, Uyeda H T, Goldman E R, *et al.* Quantum dot bioconjugates for imaging, labelling and sensing [J]. *Nat. Mater.,* 2005, 4(6):435-446.

[4] Alivisatos A P, Gu W, Larabell C. Quantum dots as cellular probes[J]. *Ann. Rev. Biomed. Eng.,* 2005, 7:55-76.

[5] Michalet X, Pinaud F F, Bentolila L A, *et al.* Quantum dots for live cells, in vivo imaging, and diagnostics[J]. *Science,* 2005, 307(5709):538-544.

[6] Bruchez M, Moronne M, Gin P, *et al.* Semiconductor nanocrystals as fluorescent biological labels[J]. *Science,* 1998, 281(5385):2013-2016.

[7] Chan W C W, Nie S. Quantum dot bioconjugates for ultrasensitive nonisotopic detection[J]. *Science,* 1998, 281(5385):2016-2018.

[8] Gao X, Cui Y, Levenson R M, *et al.* In vivo cancer targeting and imaging with semiconductor quantum dots [J]. *Nat. Biotechnol.,* 2004, 22(8):969-976.

[9] Wu X, Liu H, Liu J, *et al.* Immunofluorescent labeling of cancer marker Her2 and other cellular targets with

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semiconductor quantum dots[J]. *Nat. Biotechnol.,* 2002, 21(1):41-46.

[10] Yang C S, Chang C H, Tsai P J, *et al.* Nanoparticle-based in vivo investigation on blood-brain barrier permeability following ischemia and reperfusion[J]. *Anal. Chem.,* 2004, 76(15):4465-4471.

[11] Kolodny L A, Willard D M, Carillo L L, *et al.* Spatially correlated fluorescence/AFM of individual nanosized particles and biomolecules[J]. *Anal. Chem.,* 2001, 73(9):1959-1966.

[12] Santra S, Zhang P, Wang K, *et al.* Conjugation of biomolecules with luminophore-doped silica nanoparticles for photostable biomarkers[J]. *Anal. Chem.,* 2001, 73(20):4988-4993.

[13] Zhao X, Hilliard L R, Mechery S J, *et al.* A rapid bioassay for single bacterial cell quantitation using bioconjugated nanoparticles[J]. *Proc. Natl. Acad. Sci. USA,* 2004, 101(42):15027-15032.

[14] Ow H, Larson D R, Srivastava M, *et al.* Bright and stable core-shell fluorescent silica nanoparticles[J]. *Nano Lett.,* 2005, 5(1):113-117.

[15] Wang L, Yang C, Tan W. Dual-luminophore-doped silica nanoparticles for multiplexed signaling[J]. *Nano Lett.,* 2005, 5(1):37-43.

[16] Graf C, Schartl W, Fischer K, *et al.* Dye-labeled polyorganosiloxane-μ-gels with core-shell architecture[J]. *Langmuir,* 1999, 15(19):6170-6180.

[17] Derfus A M, Chan W C W, Bhatia S N. Probing the cytotoxicity of semiconductor quantum dots[J]. *Nano Lett.,* 2004, 4(1):11-18.

[18] Kirchner C, Liedl T, Kudera S, *et al.* Cytotoxicity of colloidal CdSe and CdSe/ZnS nanoparticles[J]. *Nano Lett.,* 2005, 5(2):331-338.

[19] Wu C, Szymanski C, McNeill J. Preparation and encapsulation of highly fluorescent conjugated polymer nanoparticles[J]. *Langmuir,* 2006, 22(7):2956-2960.

[20] Wu C, Chiu D T. Highly Fluorescent semiconducting polymer dots for biology and medicine[J]. *Angew. Chem. Int. Ed.,* 2013, 52(11):3086-3109.

[21] Wang L, Zhao W, Tan W. Bioconjugated silica nanoparticles:development and applications[J]. *Nano Res.,* 2008, 1(2):99-115.

[22] Ye F, Wu C, Jin Y, *et al.* A compact and highly fluorescent orange-emitting polymer dot for specific subcellular imaging[J]. *Chem. Commun.,* 2012, 48(12):1778-1780.

[23] Wu C, Bull B, Szymanski C, *et al.* Multicolor conjugated polymer dots for biological fluorescence imaging[J]. *ACS Nano,* 2008, 2(11):2415-2423.

[J]. 2010,31(1): 119-125

20.生物偶联过程对于聚合物包覆的水溶性CdSe/ZnS核壳量子点发光的影响[J]. 2010,31(1): 101-104