吉首大学学报自然科学版 » 2009, Vol. 30 » Issue (4): 84-91 DOI:

量子点在定量分析中的应用研究综述

(吉首大学化学化工学院，湖南 吉首 416000)

Application of Quantum Dots in Quantitative Analysis

(College of Chemistry and Chemical Engineering,Jishou University,Jishou,416000,Hunan China)

全文: PDF (1726 KB) HTML (1 KB) 输出: BibTeX | EndNote (RIS) 背景资料

摘要 量子点因其独特而优良的可见区荧光性质已在生物和医学的研究及应用方面取得了很大进展.近年来，量子点的应用已扩展至重金属离子、无机有机分子及药物的定量分析方面.分析和综述了量子点在上述3方面的生物连接方法及定量分析方面的应用，预测了未来发展的方向.

关键词: 量子点 定量分析 应用

Abstract: Quantum dots have been used extensively for a wide range of application in biological detection and medical research based on their unique and excellent nature of the fluorescence.Recent advances have shown that the application of quantum dot has been extended to quantitative analysis for inorganic heavy metal ions,organic small molecule and drugs.In this article,we discuss recent developments in Qds bio-conjugation,their applications in quantitative analysis as well as promising directions for future research.

Key words: quantum dot inorganic heavy metal ions；organic small molecule；drug；quantitative analysis

基金资助:

湖南省教育厅自科基金重点项目(05A009)；湖南大学化学生物传感与计量学国家重点实验室开放课题(2005019)；吉首大学回校博士基金资助项目

通讯作者: 陈莉华（1961-）,女，湖南吉首人，吉首大学化学化工学院教授，博士，主要从事生物化学分析及纳米粒子在化学上的应用研究，E-mail chenlihua99@163.com.

引用本文:

张文龙,陈莉华. 量子点在定量分析中的应用研究综述[J]. 吉首大学学报自然科学版, 2009, 30(4): 84-91.

ZHANG Wen-Long,CHEN Li-Hua. Application of Quantum Dots in Quantitative Analysis[J]. Journal of Jishou University(Natural Sciences Edit, 2009, 30(4): 84-91.

[1] CHEN B,YU Y,ZHOU Z T,et al.Synthesis of Novel Nanocrystals as Fluorescent Sensors for Hg2+ Ions [J].Chem. Lett.,2004,33(12):1 608-1 609.

[2] CHEN J L,GAO Y C,XU Z B,et al.A Novel Fluorescent Array for Mercury(II) Ion in Aqueous Solution with Functionalized Cadmium Selenide Nanoclusters [J].Anal. Chim. Acta,2006,577(1):77-84.

[3] CAI Z X,YANG H,ZHANG Y,et al.Preparation,Characterization and Evaluation of Water-Soluble l-Cysteine-Capped-CdS Nanoparticles as Fluorescence Probe for Detection of Hg(II) in Aqueous Solution [J].Anal. Chim. Acta,2006,559(2):234-239.

[4] 郑爱芳,方典军,陈金龙.功能化硒化镉量子点的制备以及作为汞离子荧光探针的研究 [J].安庆师范学院学报：自然科学版,2008,14(2):12-17.

[5] XIA Y S,ZHU C Q.Use of Surface-Modified CdTe Quantum Dots as Fluorescent Probes in Sensing Mercury (II) [J].Talanta,2008,75(1):215-221.

[6] LI H B,ZHANG Y,WANG X Q,et al.Calixarene Capped Quantum Dots as Luminescent Probes for Hg2+ Ions [J].Mater. Lett.,2007,61(7):1 474-

1 477.

[7] LIANG J G,AI X P,HE Z K,et al.Functionalized CdSe Quantum Dots as Selective Silver Ion Chemodosimeter [J].Analyst,2004,129(7):619-622.

[8] GATT S-ASFURA K M,LEBLANC R M.Peptide-Coated CdS Quantum Dots for the Optical Detection of Copper(II) and Silver(I) [J].Chem. Commun.,2003(21): 2 684-2 685.

[9] CHEN J L,ZHU C Q.Functionalized Cadmium Sulfide Quantum Dots as Fluorescence Probe for Silver ion Determination [J].Anal. Chim. Acta,2005,546(2):147-153.

[10] XIA Y S,CAO C,ZHU C Q.Two Distinct Photoluminescence Responses of CdTe Quantum Dots to Ag (I) [J].Journal of Luminescence,2008,128 (1):166-172.

[11] LAI S J,CHANG X J,MAO J,et al.Determination of Silver Ion with Cadmium Sulfide Quantum Dots Modified by Bismuthiol II as Fluorescence Probe [J].Anal. Chim.,2007,97(1/2):109-121.

[12] ISAROV A,CHRYSOCHOOS J.Optical and Photochemical Properties of Nonstoichiometric Cadmium Sulfide Nanoparticles:Surface Modification with Copper(II) Ions [J].Langmuir,1997,13(12):3 142-3 149.

[13] CHEN Y F,ROSENZWEIG Z.Luminescent CdS Quantum Dots as Selective Ion Probes [J].Anal. Chem.,2002,74(19):5 132-5 138.

[14] XIE H Y,LIANG J G,ZHAGNG Z L,et al.Luminescent CdSe-ZnS Quantum Dots as Selective Cu2+ Probe [J].Spectrochim. Acta Part A,2004,60 (11):2 527-2 530.

[15] FERN NDEZ-ARG ELLS M T,JIN W J,COSTA-FERN NDEZ J M,et al.Surface-Modified CdSe Quantum Dots for the Sensitive and Selective Determination of Cu(II) in Aqueous Solutions by Luminescent Measurements [J].Anal. Chim. Acta,2005,549(1-2):20-25.

[16] 闫玉禧,牟颖,金钦汉.一种新型CdTe量子点关于测定铜离子的研究 [J].生命科学仪器,2007,5(3):14-18.

[17] 刘迪,程伟青,严拯宇.硫化镉纳米粒子的合成及荧光猝灭法测定Cu2+的初步研究 [J].分析化学,2007,35(6):825-829.

[18] 严拯宇,庞代文.量子点荧光猝灭法测定中药饮片中的微量铜 [J].中国药科大学学报,2005,36(3):40-43.

[19] ZHANG Y H,ZHANG H S,GUO X F,et al.L-Cysteine-Coated CdSe/CdS Core-Shell Quantum Dots as Selective Fluorescence Probe for Copper (II) Determination [J].Microchemical Journal,2008,89(2):142-147.

[20] 吴东平,张勇,冯如朋,等.痕量铜的CdS/ZnS量子点荧光猝灭测定 [J].分析测试学报,2008,27(6):638-640.

[21] 汪乐余,朱英贵,朱昌青,等.硫化镉纳米荧光探针荧光猝灭法测定痕量铜 [J].分析化学,2002,30(11):1 352-1 354.

[22] 王柯敏,王益林,李朝辉,等.CdTe量子点荧光猝灭法测定铜离子的研究 [J].湖南大学学报:自然科学版,2005,32(3):2-6.

[23] CHEN B,ZHONG P.A New Determining Method of Copper(II) Ions at ng·mL-1 Levels Based on Quenching of the Water-Soluble Nanocrystals Fluorescence [J].Anal. Bioanal. Chem.,2005,381(4):986-992.

[24] 陈波,曾娴,戴燕,等.碲化镉纳米晶荧光猝灭法测定痕量铜(Ⅱ) [J].分析科学学报,2005,21(6):633-636.

[25] 赖艳,钟萍,俞英.新型量子点的合成及荧光法测定痕量Cu(Ⅱ) [J].化学试剂,2006,28(3):135-138.

[26] ZHANG L H,SHANG L,DONG S J.Sensitive and Selective Determination of Cu2+ by Ectrochemiluminescence of CdTe Quantum Dots [J].Electrochem. Commun.,2008,10(10):1 452-1 454.

[27] LI H B,WANG X Q.Single Quantum Dot-Micelles Coated with Gemini Surfactant for Selective Recognition of a Cation and an Anion in Aqueous Solutions [J].Sensors and Actuators B:Chemical,2008,134(1):238-244.

[28] ALI E M,ZHENG Y,YU H H,et al.Ultrasensitive Pb2+ Detection by Glutathione-Capped Quantum Dots [J].Anal. Chem.,2007,79(24):9 452-9 458.

[29] 叶敏,张友玉,杨琴,等.半胱胺修饰的CdS纳米粒子荧光猝灭法测定锰离子 [J].应用化学,2008,25(5):534-538.

[30] LI H B,ZHANGY,WANG X Q.l-Carnitine Capped Quantum Dots as Luminescent Probes for Cadmium Ions [J].Sensors and Actuators B:Chemical,2008,127(2):593-597.

[31] MYUNG N,BAE Y,BARD A J.Enhancement of the Photoluminescence of CdSe Nanocrystals Dispersed in CHCl3 by Oxygen Passivation of Surface States [J].Nano letters,2003,3(6):747-749.

[32] 陈志兵,王鹏,李艳,等.功能性CdTe纳米荧光探针的合成及光谱性质研究 [J].宿州学院学报:自然科学版,2007,22(5):106-108.

[33] 阎小青,尚卓镇,王煜,等.基于三乙醇胺修饰的CdSe 量子点两步荧光猝灭作用传感水溶液中一氧化氮 [A]//中国化学会第26届学术年会分析化学分会场论文集 [C].2008.

[34] DIAO X L,XIA Y S,ZHANGT L,et al.Fluorescence-Detecting Cationic Surfactants Using Luminescent CdTe Quantum Dots as Probes [J].Anal. Bioanal. Chem.,2007,388(5/6):1 191-1 197.

[35] VAEEILTSOVA O V,ZHAO Z Y,PETRUKINA M A,et al.Surface-Functionalized CdSe Quantum Dots for the Detection of Hydrocarbons [J].Sensors and Actuators B,2007,123(1):522-529.

[36] CONSTANTINE C A,GATTAS-ASFURA K M,MELLO S V,et al.Layer-by-Layer Films of Chitosan,Organophosphorus Hydrolase and Thioglycolic Acid-Capped CdSe Quantum Dots for the Detection of Paraoxon [J].J. Phys. Chem. B.,2003,107(50):13 762-13 764.

[37] JI X J,ZHANGJ Y,XU J M,et al.(CdSe)ZnS Quantum Dots and Organophosphorus Hydrolase Bioconjugate as Biosensors for Detection of Paraoxon [J].J. Phys. Chem. B.,2005,109(9):3 793-3 799.

[38] SHI G H,SHANG Z B,WANG Y,et al.Fluorescence Quenching of CdSe Quantum Dots by Nitroaromatic Explosives and Their Relative

Compounds [J].Spectrochimica Acta Part A:Molecular and Biomolecular Spectroscopy,2008,70(2):247-252.

[39] 张毅.水溶性量子点碲化镉测定同型半胱氨酸的研究 [J].分析测试学报,2008,27(8):844-847.

[40] NAZZAL A Y,QU L H,PENG X G,et al.Photoactivated CdSe Nanocrystals as Nanosensors for Gases [J].Nano Letters,2003,3(6):819-822.

[41] HUANG C P,LI Y K,CHEN T M.A Highly Sensitive System for Urea Detection by Using CdSe/ZnS Core-Shell Quantum Dots [J].Biosens. Bioelectron.,2007,22(8):1 835-1 838.

[42] YUAN J P,GUO W W,WANG E K.Quantum Dots-Bienzyme Hybrid System for the Sensitive Determination of Glucose [J].Biosens. bioelectron.,2008,23(10):1 567-1 571.

[43] MATTOUSSI H,MAURO J M,GOLDMAN E R,et al.Self-Assembly of CdSe-ZnS Quantum Dot Bioconjugates Using an Engineered Recombinant Protein [J].J. Am. Chem. Soc.,2000,122(49):12 142-12 150.

[44] HONG DINH DUONGA,JONG II RHEE.Use of CdSe/ZnS Core-Shell Quantum Dots as Energy Transfer Donors in Sensing Glucose [J].Talanta,2007,73(5):899-905.

[45] GOLDMAN E R,MEDINTZ I L,WHITLEY J L,et al.A Hybrid Quantum Dot?Antibody Fragment Fluorescence Resonance Energy Transfer-Based TNT Sensor [J].J. Am. Chem. Soc.,2005,127(18):6 744-6 751.

[46] 汪乐余,郭畅,李茂国,等.功能性硫化镉纳米荧光探针荧光猝灭法测定核酸 [J].分析化学,2003,31(1):83-86.

[47] 徐靖,赵应声,王洪梅,等.应用水相合成的CdTe/CdS核壳型量子点荧光探针测定DNA [J].分析试验室,2006,25(4):50-53.

[48] 汪乐余,周运友,朱昌青,等.功能性CdS 纳米荧光探针荧光增敏法测定人血清白蛋白 [J].高等学校化学学报,2003,24(4):612-614.

[49] YU Y,LAI Y,ZHENG X L,et al.Synthesis of Functionalized CdTe/CdS QDs for Spectrofluorimetric Detection of BSA [J].Spectrochim Acta A Mol Biomol Spectrosc,2007,68(5):1 356-1 361.

[50] 钟萍.11-巯基烷酸修饰CdSe/CdS纳米晶的合成及荧光增敏法测定溶菌酶 [J].应用化学,2007,24(12):1 428-1 432.

[51] 陈莉华,覃事栋,卜晓英,等.胃蛋白酶对CdS 纳米粒子的表面修饰及分析应用 [J].吉首大学学报:自然科学版,2008,29(2):96-100.

[52] 陈莉华,覃事栋,李朝阳.胃蛋白酶对CdTe纳米粒子的表面修饰及分析应用 [J].高等学校化学学报,2008,29(2):277-282.

[53] 陈莉华,卜晓英,文世才,等.CdSe量子点的合成及标记胃蛋白酶的研究 [J].分析化学,2007,35(8):1 211-1 214.

[54] 李平,刘梅川,张成林,等.聚乙烯吡咯烷酮/硫化镉量子点修饰电极的制备及其对血红蛋白的测定研究 [J].化学学报,2005,63(12):1 075-1 080.

[55] 张莉,刘梅川,程欲晓,等.PVP/CdS量子点修饰电极的制备及其对肌红蛋白的直接电化学研究 [J].化学传感器,2005,25(2):51-56.

[56] LIANG J G,HUANG S,ZENG D Y,et al.CdSe Quantum Dots as Luminescent Probes for Spironolactone Determination [J].Talanta,2006,69 (1):126-130.

[57] LIAO Q G,LI Y F,HUANG C Z.CdS Quantum Dots as Fluorescence Probes for Detection of Adriamycin Hydrochloride [J].Chem. Res. Chinese U.,2007,23(2):138-142.

[58] 张犁黎,郑行望,屈颖娟,等.硫化镉纳米粒子荧光猝灭测定柳氮磺吡啶 [J].陕西师范大学学报:自然科学版,2006,34(2):74-76.

[59] WANG Y Q,Ye C,ZHU Z H,et al.Cadmium Telluride Quantum Dots as pH-Sensitive Probes for Tiopronin Determination [J].Anal. Chim. acta,2008,610(1):50-56.

[60] LIU M,Xu L,CHENG W,et al.Surface-Modified CdS Quantum Dots as Luminescent Probes for Sulfadiazine Determination [J].Spectrochim Acta A Mol Biomol Spectrosc.,2008,70(5):1 198-1 202.

[61] 田建衾,韦盛志,赵彦春,等.CdSe/CdS量子点荧光猝灭法测定芹黄素的研究 [J].分析试验室,2008,27(10):19-22.

[62] SUN J F,REN C L,LIU L H,et al.CdTe Quantum Dots as Fluorescence Sensor for the Determination of Vitamin B6 in Aqueous Solution [J].Chinese Chemical Letters,2008,19(7):855-859.

[63] SUN J F,LIU L H,REN C L,et al.A Feasible Method for the Sensitive and Selective Determination of Vitamin B1 with CdSe Quantum Dots [J].Microchimica Acta,2008,163(3-4):271-276.

[64] LI D,YAN Z Y,CHENG W Q.Determination of Ciprofloxacin with Functionalized Cadmium Sulfide Nanoparticles as a Fluorescence Probe [J].Spectrochim Acta A Mol Biomol Spectrosc.,2008,71(4):1 204-1 211.

[65] 凌霞,邓大伟,钟文英,等.水溶性量子点荧光探针用于帕珠沙星的含量测定 [J].光谱学与光谱分析,2008,28(6):1 317-1 321.

[66] 王齐,刘忠芳,刘绍璞.硫化镉纳米微粒作探针共振瑞利散射测定某些蒽环类抗癌药物 [J].高等学校化学学报,2007,28(5):837-842.

[67] 闫炜,张爱梅,王怀生.CdTe/CdS量子点共振瑞利散射光谱法测定细胞色素C [J].理化检验:化学分册,2008,44(2):107-110.

[68] 刘正文,刘绍璞,王雷,等.水溶性硫化镉量子点作探针共振瑞利散射测定某些氨基糖苷类抗生素 [A]//中国化学会第26届学术年会纳米化学分会场论文集[C].2008.

[1] 杨志芬, 陈莉华, 廖美林, 刘洪文, 刘佩, 刘建健. **野菊花精油的提取及其在功能性日用品中的应用**[J]. 吉首大学学报自然科学版, 2011, 32(6): 89-92.

[2] 张文龙, 张俊生, 周丽平, 陈莉华. **牛血清白蛋白修饰水溶性CdTe量子点及分析应用**[J]. 吉首大学学报自然科学版, 2011, 32(1): 93-97.

[3] 易唐唐. **网络资源在高校计算机教学中的应用**[J]. 吉首大学学报自然科学版, 2010, 31(2): 122-124.

[4] 张一方. **数学中场论的某些新探索及其在物理学中的应用**[J]. 吉首大学学报自然科学版, 2010, 31(1): 47-53.

通讯地址：湖南省吉首市人民南路120号《吉首大学学报》编辑部 邮编：416000
电话传真：0743-8563684 E-mail：xb8563684@163.com 办公QQ：1944107525