张丽华

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女 博导 中国科学院大连化学物理研究所

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研究领域

1. 研制高新型样品预处理和分离材料

 针对蛋白质组等复杂样品的分析需求，着重研制新型整体材料、聚合物颗粒、硅胶颗粒等，并对其表面进行功能修饰，以实现样品的高效低残留的预处理和分离。

2. 发展蛋白质组定量新方法新技术

 发展基于色谱，以及一级/二级质谱的标记和非标记的相对和绝对定量新方法，提高规模化蛋白质定量的准确度和精密度。

3. 构建集成化分析平台

 发展蛋白质变性、还原、酶解、标记等技术，并与微纳升级液相色谱-质谱联用，构建集成化蛋白质定性和定量分析平台，为实现高通量、高精密度和高准确性的规模化蛋白质分析提供关键技术支撑。

招生信息

招生专业

070302-分析化学

招生方向

生物样品分离与表征

色谱质谱联用

蛋白质组定性定量分析

教育背景

1995-09--2000-10 中科院大连化学物理研究所 博士

1991-09--1995-07 吉林大学 本科

学历

中国科学院大连化学物理研究所 19950901--20001201 研究生毕业

学位

中国科学院大连化学物理研究所 19950901--20001201 博士

出国学习工作

19991001-20000930 德国国家环境与生态中心 博士生联合培养

20000101-20030330 日本德岛大学 博士后

20080101-20080228 德国多特蒙德大学 高级访问学者

工作经历

工作简历

2003-04~现在, 中科院大连化学物理研究所, 副研究员、研究员、课题组长

2001-01~2003-03,日本德岛大学, 博士后

社会兼职

2013-01-01-今,Sci Rep 编委,

2012-01-01-今,Anal Bioanal Chem中国区域主编,

2012-01-01-今,Proteomics编委,

2011-01-01-今,Anal Chem 编委,

教授课程

蛋白质定性定量分析新方法

色谱分离材料

出版信息

发表论文

（1） 3-Carboxybenzoboroxole Functionalized Polyethylenimine Modified Magnetic Graphene Oxide Nanocomposites for Human Plasma Glycoproteins Enrichment under Physiological Conditions, Analytical Chemistry, 2018, 通讯作者

（2） Integrated Platform with Combination of On-line Protein Digestion, Isotope Dimethyl Labeling and Multidimensional Peptide Separation for High-throughput Proteome Quantification, Analytica Chimica Acta, 2018, 通讯作者

（3） Enzymatic Reactor with Trypsin Immobilized on Graphene Oxide Modified Polymer Microspheres to Achieve Automated Proteome Quantification, Analytical Chemistry, 2017, 通讯作者

（4） In-Depth Proteome Coverage by Improving Efficiency for Membrane Proteome Analysis, Analytical Chemistry, 2017, 通讯作者

（5） Hydrophilic GO/Fe3O4/Au/PEG Nanocomposites for Highly Selective Enrichment of Glycopeptides, Nanoscale, 2016, 通讯作者

（6） Glycan Moieties as Bait to Fish Plasma Membrane Proteins, Analytical Chemistry, 2016, 通讯作者

（7） An efficient approach to prepare boronate core-shell polymer nanoparticles for glycoprotein recognition via combined distillation precipitation polymerization and RAFT media precipitation polymerization, Chemical Communications, 2015, 通讯作者

（8） Releasing N-glycan from peptide N-terminus by N-terminal succinylation assisted enzymatic deglycosylation, Scientific Reports, 2015, 通讯作者

（9） Surface-Imprinted Nanoparticles Prepared with a His-Tag-Anchored Epitope as the Template, Analytical Chemistry, 2015, 通讯作者

（10） New GO-PEI-Au-L-Cys ZIC-HILIC, composites: synthesie and selective enrichment of glycopeptides, Nanoscale, 2014, 通讯作者

（11） 1-Dodecyl-3-methylimidazolium chloride-assisted sample preparation method for efficient integral membrane proteome analysis, Analytical Chemistry, 2014, 通讯作者

（12） Biphasic Microreactor for Efficient Membrane Protein Pretreatment with a Combination of Formic Acid Assisted Solubilization, On-Column pH Adjustment, Reduction, Alkylation, and Tryptic Digestion, Analytical Chemistry, 2013, 通讯作者

（13） Synthesis of adenosine functionalized metal immobilized magnetic nanoparticles for highly selective and sensitive enrichment of phosphopeptides, Chemical Communications, 2012, 通讯作者

（14） Boronic Acid Functionalized Core-Shell Polymer Nanoparticles Prepared by Distillation Precipitation Polymerization for Glycopeptide Enrichment, Chemistry-a European Journal, 2012, 通讯作者

（15） Hydrophilic immobilized trypsin reactor with magnetic graphene oxide as support for high efficient proteome digestion, Journal of Chromatography A, 2012, 通讯作者

（16） Preparation of a new type of affinity materials combining metal coordination with molecular imprinting, Chemical Communications, 2011, 通讯作者

（17） Development of a Highly Efficient 2-D System with a Serially Coupled Long Column and Its Application in Identification of Rat Brain Integral Membrane Proteins with Ionic Liquids-Assisted Solubilization and Digestion, Journal of Proteome Research, 2011, 通讯作者

（18） Hydrophilic monolith based immobilized enzyme reactors in capillary and on microchip for high-throughput proteomic analysis, Journal of Chromatography A, 2011, 通讯作者

（19） Immobilized enzyme reactors in proteomics, TRAC-Trends in analytical chemistry, 2011, 通讯作者

（20） Intergrated Device for Online Sample Buffer Exchange, Protein Enrichment, and Digestion, Analytical Chemistry, 2010, 通讯作者

（21） Coupling Formic Acid Assisted Solubilization and online Immobi-lized Pepsin Microreactor Digestion with SCX-μPRLC-ESI-MS/MS for Integral Membrane Proteome Analysis, Analytical Chemistry, 2010, 通讯作者

（22） Organic-Inorganic Hybrid Silica Monolith Based Immobilized Titanium Ion Affinity Chromatography Column for Analysis of Mitochondrial Phosphoproteome, Journal of Proteome Research, 2010, 通讯作者

发表著作

（1） 蛋白质组学研究-概念、技术及英语, Proteome Research, Concepts, Technology and Application, 科学出版社, 2010-05, 第 1 作者

科研活动

科研项目

（ 1 ） 蛋白质样品多级预处理系统的研制, 主持, 国家级, 2011-01--2013-12

（ 2 ） 蛋白质组分离鉴定新技术新方法用于肿瘤转移预警研究, 主持, 国家级, 2010-07--2012-06

（ 3 ） 肿瘤早期诊断标志物筛选和发现的蛋白质组学分析新方法, 参与, 国家级, 2010-09--2012-08

（ 4 ） 蛋白质分离检测和定量的新技术新方法研究, 参与, 国家级, 2010-09--2012-12

（ 5 ） 蛋白质定量新方法及相关技术研究, 主持, 国家级, 2012-01--2016-12

（ 6 ） 基于核酸适配体的亲和富集和分离新方法研究, 主持, 国家级, 2012-01--2016-12

（ 7 ） 基于蛋白质组和代谢组动态变化分析的大气细颗粒物健康效应研究新方法, 主持, 国家级, 2016-01--2019-12

（ 8 ） 深度覆盖的蛋白质组精准鉴定与定量技术, 主持, 国家级, 2017-07--2022-06

（ 9 ） 纯化蛋白质的全序列高准确测定技术, 主持, 国家级, 2017-07--2022-06

参与会议

（1）Novel monolithic materials for proteome analysis 第四十六届高效液相分离和相关技术国际研讨会 2017-11-05

（2）Quantitative Analysis of Proteomic Samples by Novel LC-MS/MS based Methods 第四十四届高效液相分离和相关技术国际研讨会 2016-06-18

（3）Ionic liquid based sample preparpation method for membrane proteome analysis 中德“色谱和质谱在组学的研究进展”双边研讨会 张丽华 2015-06-19

（4）MS compatible sample preparation methods for proteome analysis 韩国质谱学会2014年年会 赵群，方菲，张丽华，张玉奎 2014-08-19

（5）New Materials for Selctive Enrichment of Glycoproteins/peptides for Proteome Analysis 第四十一届高效液相分离和相关技术国际研讨会 张丽华，江波，吴慈，曲焱焱，梁玉，张玉奎 2014-05-11

（6）Novel Sample Preparation Materials for Proteome Analysis 第十五届北京分析测试学术报告会暨展览会 赵群，方菲，张丽华，张玉奎 2013-10-22

（7）New materials and techniques for micro/nano-scale sample preparation and 第五届国际微化学与微系统学术会议(ISMM 2013) 张丽华 2013-05-16

（8）Advance on New Separation and Identification Techniques for Proteome Analysis 2011年IUPAC国际分析科学会议 张丽华，张晓丹，张玉奎 2011-05-22

（9）Integrated sample preparation devices and application in proteome study 生命科学中的分析技术：机遇与挑战 张丽华，张玉奎 2011-05-19

（10）蛋白质分析的分离鉴定新技术研究进展 2011年IUPAC国际分析科学会议 张丽华，张玉奎 2011-05-17

（11）New Methods and Platforma for Liquid Phase Based Proteome Separation and Identification　 第三十五届高效液相分离和相关技术国际研讨会 张丽华，周愿，袁辉明，朱贵杰，乔小强，孙良亮，梁振，张玉奎 2010-06-19

奖励信息

（1） 第十四届中国青年科技奖, 部委级, 2016

（2） 中国青年女科学家奖, 专项, 2015

（3） 中国女分析化学家, , 专项, 2015

（4） 第九届辽宁青年科技奖（十大英才）, , 省级, 2013

（5） 中青年科技创新领军人才(万人计划), , 部委级, 2013

（6） 复杂生物样品的高效分离与表征, 二等奖, 国家级, 2012

（7） 复杂生物样品的高效分离与表征, 一等奖, 省级, 2011

（8） 中国化学会青年化学奖, , 其他, 2008

（9） 毛细管电色谱新方法和新技术研究, 一等奖, 省级, 2004

（10） 毛细管电色谱新方法和新技术研究, 一等奖, 省级, 2004

专利成果

（ 1 ） 一种聚乙二醇偶联结合超滤离心分离富集糖肽的方法 , 发明, 2014, 第 1 作者, 专利号: 201110104461.X

（ 2 ） 一种毛细管整体柱及在固定化胰酶中的应用, 发明, 2013, 第 1 作者, 专利号: ZL201010522957.4

（ 3 ） 一种蛋白质分子印迹聚合物颗粒的制备方法, 发明, 2013, 第 1 作者, 专利号: ZL200910248928.0

（ 4 ） 一种连接接口及其在微流控芯片系统中的应用, 发明, 2011, 第 1 作者, 专利号: ZL200810228630.9

（ 5 ） 一种固载蛋白质的多孔整体基质及其制备, 发明, 2009, 第 1 作者, 专利号: ZL200510047989.2

（ 6 ） 一种用于蛋白质样品富集及与毛细管电泳分析联用的方法, 发明, 2012, 第 1 作者, 专利号: ZL200710012042.7

（ 7 ） 一种电喷雾质谱中多磷酸化位点肽段的检测和鉴定方法, 发明, 2011, 第 1 作者, 专利号: ZL200610134982.9

（ 8 ） 一种固定化金属离子亲和色谱整体柱的制备方法, 发明, 2012, 第 1 作者, 专利号: ZL200910248935.0

（ 9 ） 一种铁离子固定化亲和色谱整体柱的制备方法, 发明, 2013, 第 1 作者, 专利号: CN200910248846.6

（ 10 ） 一种18O在线标记的蛋白质定量分析平台及其操作方法, 发明, 2015, 第 1 作者, 专利号: 201210554634.2

（ 11 ） 一种高通量蛋白质样品预处理装置, 发明, 2015, 第 1 作者, 专利号: 201210517241.4

（ 12 ） 基于亲水作用机理富集糖肽的酰胺型整体柱及制备和应用, 发明, 2016, 第 1 作者, 专利号: 201210560167.4

（ 13 ） 一种有序介孔核壳结构硅胶色谱填料及其制备和应用, 发明, 2016, 第 1 作者, 专利号: 201310106742.8

（ 14 ） 一种有机无机杂化微球颗粒及其制备和应用, 发明, 2017, 第 1 作者, 专利号: 201310370095.1

（ 15 ） 固载核酸适体的整体材料的制备和在蛋白在线检测的应用, 发明, 2017, 第 1 作者, 专利号: 201310554485.4

（ 16 ） 一种有机无机杂化微球颗粒及其制备和应用, 发明, 2018, 第 1 作者, 专利号: 201410748234.4

Zhang Lihua

<https://teacher.ucas.ac.cn/~0000545>

Gender: Female

Personal Profile:

Title: Doctoral Supervisor of Dalian Institute of Chemical Physics, Chinese Academy of Sciences

E-mail: lihuazhang@dicp.ac.cn

Mailing Address: No. 457, Zhongshan Road, Dalian City

Postal Code: 116023

Research Fields:

1. Development of Advanced Sample Pretreatment and Separation Materials:

Focusing on the analysis needs of complex samples such as proteomes, new materials including monolithic materials, polymer particles, and silica particles are developed and functionally modified to achieve efficient and low-residue sample pretreatment and separation.

2. Development of New Quantitative Methods and Technologies for Proteomes:

Developing new methods for relative and absolute quantification based on chromatography and primary/secondary mass spectrometry, labeled and label-free, to improve the accuracy and precision of large-scale protein quantification.

3. Construction of Integrated Analytical Platforms:

Developing technologies for protein denaturation, reduction, enzymatic digestion, labeling, and combining them with micro-nano upgraded liquid chromatography-mass spectrometry to construct integrated platforms for qualitative and quantitative protein analysis, providing key technical support for high-throughput, high-precision, and high-accuracy large-scale protein analysis.

Admissions Information:

Specialization: Analytical Chemistry (070302)

Research Directions:

Separation and characterization of biological samples

Chromatography-mass spectrometry coupling

Qualitative and quantitative analysis of proteomes

Educational Background:

1995-09 to 2000-10: Ph.D. from Dalian Institute of Chemical Physics, Chinese Academy of Sciences

1991-09 to 1995-07: Bachelor's Degree from Jilin University

Graduation: Postgraduate of Dalian Institute of Chemical Physics, Chinese Academy of Sciences (1995-09-01 to 2000-12-01)

Degree: Ph.D. from Dalian Institute of Chemical Physics, Chinese Academy of Sciences (1995-09-01 to 2000-12-01)

International Study and Work Experience:

1999-10-01 to 2000-09-30: Joint Ph.D. Training of German National Center for Environment and Ecology

2000-01-01 to 2003-03-30: Postdoctoral Researcher of University of Tokushima

2008-01-01 to 2008-02-28: Senior Visiting Scholar of Dortmund University of Technology

Work Experience:

2003-04 to Present: Associate Researcher, Researcher, and Project Leader of Dalian Institute of Chemical Physics, Chinese Academy of Sciences

2001-01 to 2003-03: Postdoctoral Researcher of University of Tokushima

Academic and Professional Positions:

2013-01-01 to Present: Editorial Board Member of Sci Rep

2012-01-01 to Present: China Regional Editor of Anal Bioanal Chem

2012-01-01 to Present: Editorial Board Member of Proteomics

2011-01-01 to Present: Editorial Board Member of Anal Chem

Courses Taught:

New Methods for Qualitative and Quantitative Protein Analysis

Chromatographic Separation Materials

Publications:

Papers:

(1) 3-Carboxybenzoboroxole Functionalized Polyethylenimine Modified Magnetic Graphene Oxide Nanocomposites for Human Plasma Glycoproteins Enrichment under Physiological Conditions, Analytical Chemistry, 2018, Corresponding Author

(2) Integrated Platform with Combination of On-line Protein Digestion, Isotope Dimethyl Labeling and Multidimensional Peptide Separation for High-throughput Proteome Quantification, Analytica Chimica Acta, 2018, Corresponding Author

(3) Enzymatic Reactor with Trypsin Immobilized on Graphene Oxide Modified Polymer Microspheres to Achieve Automated Proteome Quantification, Analytical Chemistry, 2017, Corresponding Author

(4) In-Depth Proteome Coverage by Improving Efficiency for Membrane Proteome Analysis, Analytical Chemistry, 2017, Corresponding Author

(5) Hydrophilic GO/Fe3O4/Au/PEG Nanocomposites for Highly Selective Enrichment of Glycopeptides, Nanoscale, 2016, Corresponding Author

(6) Glycan Moieties as Bait to Fish Plasma Membrane Proteins, Analytical Chemistry, 2016, Corresponding Author

(7) An efficient approach to prepare boronate core-shell polymer nanoparticles for glycoprotein recognition via combined distillation precipitation polymerization and RAFT media precipitation polymerization, Chemical Communications, 2015, Corresponding Author

(8) Releasing N-glycan from peptide N-terminus by N-terminal succinylation assisted enzymatic deglycosylation, Scientific Reports, 2015, Corresponding Author

(9) Surface-Imprinted Nanoparticles Prepared with a His-Tag-Anchored Epitope as the Template, Analytical Chemistry, 2015, Corresponding Author

(10) New GO-PEI-Au-L-Cys ZIC-HILIC, composites: synthesie and selective enrichment of glycopeptides, Nanoscale, 2014, Corresponding Author

(11) 1-Dodecyl-3-methylimidazolium chloride-assisted sample preparation method for efficient integral membrane proteome analysis, Analytical Chemistry, 2014, Corresponding Author

(12) Biphasic Microreactor for Efficient Membrane Protein Pretreatment with a Combination of Formic Acid Assisted Solubilization, On-Column pH Adjustment, Reduction, Alkylation, and Tryptic Digestion, Analytical Chemistry, 2013, Corresponding Author

(13) Synthesis of adenosine functionalized metal immobilized magnetic nanoparticles for highly selective and sensitive enrichment of phosphopeptides, Chemical Communications, 2012, Corresponding Author

(14) Boronic Acid Functionalized Core-Shell Polymer Nanoparticles Prepared by Distillation Precipitation Polymerization for Glycopeptide Enrichment, Chemistry-a European Journal, 2012, Corresponding Author

(15) Hydrophilic immobilized trypsin reactor with magnetic graphene oxide as support for high efficient proteome digestion, Journal of Chromatography A, 2012, Corresponding Author

(16) Preparation of a new type of affinity materials combining metal coordination with molecular imprinting, Chemical Communications, 2011, Corresponding Author

(17) Development of a Highly Efficient 2-D System with a Serially Coupled Long Column and Its Application in Identification of Rat Brain Integral Membrane Proteins with Ionic Liquids-Assisted Solubilization and Digestion, Journal of Proteome Research, 2011, Corresponding Author

(18) Hydrophilic monolith based immobilized enzyme reactors in capillary and on microchip for high-throughput proteomic analysis, Journal of Chromatography A, 2011, Corresponding Author

(19) Immobilized enzyme reactors in proteomics, TRAC-Trends in analytical chemistry, 2011, Corresponding Author

(20) Intergrated Device for Online Sample Buffer Exchange, Protein Enrichment, and Digestion, Analytical Chemistry, 2010, Corresponding Author

(21) Coupling Formic Acid Assisted Solubilization and online Immobi-lized Pepsin Microreactor Digestion with SCX-μPRLC-ESI-MS/MS for Integral Membrane Proteome Analysis, Analytical Chemistry, 2010, Corresponding Author

(22) Organic-Inorganic Hybrid Silica Monolith Based Immobilized Titanium Ion Affinity Chromatography Column for Analysis of Mitochondrial Phosphoproteome, Journal of Proteome Research, 2010, Corresponding Author

Monographs

(1) Proteome Research, Concepts, Technology and Application, Science Press, May 2010, First Author

Scientific Research Activities

Scientific Research Projects:

(1) Development of Multistage Pretreatment Systems for Protein Samples, Principal Investigator, National Level, 2011-01 to 2013-12

(2) New Techniques and Methods for Proteome Separation and Identification for Early Warning of Tumor Metastasis, Principal Investigator, National Level, 2010-07 to 2012-06

(3) Proteomics Analysis Methods for Screening and Discovering Early Diagnostic Markers of Tumors, Participant, National Level, 2010-09 to 2012-08

(4) New Techniques and Methods for Protein Separation, Detection, and Quantification, Participant, National Level, 2010-09 to 2012-12

(5) Research on New Methods and Related Technologies for Protein Quantification, Principal Investigator, National Level, 2012-01 to 2016-12

(6) Research on New Affinity Enrichment and Separation Methods Based on Nucleic Acid Aptamers, Principal Investigator, National Level, 2012-01 to 2016-12

(7) New Methods for Studying the Health Effects of Fine Particulate Matter in the Atmosphere Based on Dynamic Analysis of Proteomes and Metabolomes, Principal Investigator, National Level, 2016-01 to 2019-12

(8) High-Coverage and Accurate Proteome Identification and Quantification Techniques, Principal Investigator, National Level, 2017-07 to 2022-06

(9) Highly Accurate Full Sequence Determination Technology for Purified Proteins, Principal Investigator, National Level, 2017-07 to 2022-06

Conference Participation

(1) Novel Monolithic Materials for Proteome Analysis, 46th International Symposium on High-Performance Liquid Phase Separations and Related Techniques, 2017-11-05

(2) Quantitative Analysis of Proteomic Samples by Novel LC-MS/MS Based Methods, 44th International Symposium on High-Performance Liquid Phase Separations and Related Techniques, 2016-06-18

(3) Ionic Liquid-Based Sample Preparation Method for Membrane Proteome Analysis, Sino-German Bilateral Symposium on Chromatography and Mass Spectrometry in Omics Research, Lihua Zhang, 2015-06-19

(4) MS Compatible Sample Preparation Methods for Proteome Analysis, Annual Meeting of the Korean Society for Mass Spectrometry 2014, Qun Zhao, Fei Fang, Lihua Zhang, Yukui Zhang, 2014-08-19

(5) New Materials for Selective Enrichment of Glycoproteins/Peptides for Proteome Analysis, 41st International Symposium on High-Performance Liquid Phase Separations and Related Techniques, Lihua Zhang, Bo Jiang, Ci Wu, Yanyan Qu, Yu Liang, Yukui Zhang, 2014-05-11

(6) Novel Sample Preparation Materials for Proteome Analysis, 15th Beijing Conference and Exhibition on Instrumental Analysis, Qun Zhao, Fei Fang, Lihua Zhang, Yukui Zhang, 2013-10-22

(7) New Materials and Techniques for Micro/Nano-Scale Sample Preparation, 5th International Symposium on Microchemistry and Microsystems (ISMM 2013), Lihua Zhang, 2013-05-16

(8) Advances on New Separation and Identification Techniques for Proteome Analysis, IUPAC International Congress on Analytical Sciences 2011, Lihua Zhang, Xiaodan Zhang, Yukui Zhang, 2011-05-22

(9) Integrated Sample Preparation Devices and Application in Proteome Study, Analytical Techniques in Life Sciences: Opportunities and Challenges, Lihua Zhang, Yukui Zhang, 2011-05-19

(10) Advances on New Separation and Identification Techniques for Proteome Analysis, IUPAC International Congress on Analytical Sciences 2011, Lihua Zhang, Yukui Zhang, 2011-05-17

(11) New Methods and Platforms for Liquid Phase-Based Proteome Separation and Identification, 35th International Symposium on High-Performance Liquid Phase Separations and Related Techniques, Lihua Zhang, Yuan Zhou, Huiming Yuan, Guijie Zhu, Xiaoqiang Qiao, Liangliang Sun, Zhen Liang, Yukui Zhang, 2010-06-19

Awards

(1) 14th China Youth Science and Technology Award, Ministerial Level, 2016

(2) Chinese Young Women in Science Award, Special, 2015

(3) Women Analytical Chemist Award of China, Special, 2015

(4) 9th Liaoning Provincial Youth Science and Technology Award (Top Ten Talents), Provincial Level, 2013

(5) Young and Middle-aged Leading Talents in Science and Technology Innovation (Ten Thousand Talents Program), Ministerial Level, 2013

(6) Second Prize in Efficient Separation and Characterization of Complex Biological Samples, National Level, 2012

(7) First Prize in Efficient Separation and Characterization of Complex Biological Samples, Provincial Level, 2011

(8) Young Chemist Award of Chinese Chemical Society, Other, 2008

(9) First Prize for New Methods and Technologies in Capillary Electrophoresis, Provincial Level, 2004

(10) First Prize for New Methods and Technologies in Capillary Electrophoresis, Provincial Level, 2004

Patents

(1) A Method for Enriching Glycopeptides by Polyethylene Glycol Coupled Ultrafiltration Centrifugal Separation, Invention, 2014, First Author, Patent No.: 201110104461.X

(2) A Capillary Monolithic Column and Its Application in Immobilized Trypsin, Invention, 2013, First Author, Patent No.: ZL201010522957.4

(3) A Method for Preparing Protein Molecularly Imprinted Polymer Particles, Invention, 2013, First Author, Patent No.: ZL200910248928.0

(4) A Connector Interface and Its Application in Microfluidic Chip Systems, Invention, 2011, First Author, Patent No.: ZL200810228630.9

(5) A Porous Monolithic Matrix for Immobilized Proteins and Its Preparation, Invention, 2009, First Author, Patent No.: ZL200510047989.2

(6) A Method for Enriching Protein Samples and Coupling with Capillary Electrophoresis Analysis, Invention, 2012, First Author, Patent No.: ZL200710012042.7

(7) A Method for Detecting and Identifying Multiphosphorylated Site Peptides in Electrospray Mass Spectrometry, Invention, 2011, First Author, Patent No.: ZL200610134982.9

(8) A Method for Preparing Immobilized Metal Ion Affinity Chromatography Monolithic Columns, Invention, 2012, First Author, Patent No.: ZL200910248935.0

(9) A Method for Preparing Iron Ion Immobilized Affinity Chromatography Monolithic Columns, Invention, 2013, First Author, Patent No.: CN200910248846.6

(10) A Quantitative Analysis Platform of Proteins for Online 18O Labeling and Its Operation Method, Invention, 2015, First Author, Patent No.: 201210554634.2

(11) A High-Throughput Protein Sample Pretreatment Device, Invention, 2015, First Author, Patent No.: 201210517241.4

(12) An Amide-Type Monolithic Column for Enriching Glycopeptides Based on Hydrophilic Interaction Mechanism and Its Preparation and Application, Invention, 2016, First Author, Patent No.: 201210560167.4

(13) A Chromatographic Packing Material with Ordered Mesoporous Core-Shell Silica Gel and Its Preparation and Application, Invention, 2016, First Author, Patent No.: 201310106742.8

(14) Organic-Inorganic Hybrid Microspheres and Their Preparation and Application, Invention, 2017, First Author, Patent No.: 201310370095.1

(15) Preparation of Immobilized Aptamer Monolithic Materials and Their Application in Online Protein Detection, Invention, 2017, First Author, Patent No.: 201310554485.4

(16) Organic-Inorganic Hybrid Microspheres and Their Preparation and Application, Invention, 2018, First Author, Patent No.: 201410748234.4