



## 师资队伍

人才团队

教师队伍

研究生导师

无机化学

有机化学

物理化学

高分子化学与物理

资源化学

分析化学

环境科学与工程

材料科学与工程

化学工程与技术

化学工程

资源与环境(环境工程方向)

博士后

## 资源化学

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### 【博导】李丽

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李丽，女，1970年出生，博士研究生，教授、资源化学博士生导师，教育部自然保护与环境生态类教学指导委员会委员。

现任黑龙江大学现代农业与生态环境学院院长兼党委副书记。2004年毕业于哈尔滨工业大学并获得环境工程专业博士学位。2004年12月在哈尔滨工程大学开展汽车尾气净化催化材料方面的博士后研究工作。现为黑龙江省土壤肥料学会副理事长，黑龙江省环境科学学会理事，担任ACS Applied Nano Materials、Journal of Porous Materials、Ecotoxicology等国际期刊的审稿人。

主要从事固废资源化利用及环境功能材料研究。主持并完成国家自然科学基金面上项目、黑龙江省自然科学基金项目、黑龙江省教育厅科学技术项目、哈尔滨市科技局学科后备带头人基金项目、黑龙江省博士后基金资助等多项；参与完成国家（部）、省级、市级科技项目20余项，获黑龙江省科学技术奖（自然类）二等奖、黑龙江省高校科学技术奖二等奖、黑龙江省自然科学技术学术成果奖等各1项；中国授权发明专利6项，出版专著1部，参编著作3部。作为第1或通讯作者，[至今已在](#)“Nanoscale、Journal of Materials Chemistry A、Sensors and Actuators B: Chemical”等上发表SCI论文40余篇，被SCI论文引用1000余次，个人SCI H因子25。

#### 一、研究方向

主要从事环境功能材料及固体废弃物资源化利用等方面研究。

#### 二、学术荣誉及获奖情况

学术荣誉：

现为教育部国家一流专业评审专家，天津市科技局、陕西省教育厅、黑龙江省科技厅、黑龙江省生态环境厅、哈尔滨市教育局等评审专家，黑龙江省土壤肥料学会副理事长，黑龙江省环境科学学会理事，黑龙江大学学位评定委员会成员，黑龙江大学三级教授，入选黑大英才库。

获奖情况：

1. 黑龙江省高等教育教学成果奖二等奖，新农科背景下基于卓越的实用型“农业+”人才培养模式的探索与实践，2020年9月，第一名。
2. 黑龙江省科学技术进步奖（自然科学类）二等奖，碳基半导体复合材料的设计合成及气敏传感器性能研究，2016年8月，第二名。
3. 黑龙江省自然科学技术三等奖，The adhesive and durability of adhesive-poly(ethylene terephthalate) film joints，2011年6月，第一。

#### 三、科研项目情况

1. 二维纳米材料 $M^{II}M^{III}$  LDHs的可控制备及 $NO_x$ 气敏性能研究（No. 21671060），国家自然科学基金项目，2017/01-2020/12，主持人
2. 低温储存还原 $NO_x$ 的稀土氧化物/石墨烯复合材料的制备及性能研究（No. B201105），黑龙江省自然科学基金，2012/01-2014/12，主持人
3.  $NO_x$ 还原与分解双功能催化剂的研制及催化机理（B200504），黑龙江省自然科学基金，2006/01-2007/12，主持人
4. LDHs改性生物质炭材料的制备及其在水中重金属离子检测（20200108），功能无机材料化学教育部重点实验室开放基金项目，2021.12-2022.12，主持人
5. LDHs的可控制备及 $NO_x$ 气敏性能研究（No. 20160020），功能无机材料化学教育部重点实验室开放基金项目，2016.12-2017.12，主持人
6. 贫燃条件下对 $NO_x$ 分解和还原的双功能催化剂的研究（No.LBH-Z05066），黑龙江省博士后资助项目，2005.01-2007.12，主持人
7.  $NO_x$ 吸附-还原（类）钙钛矿型氧化物/碳纳米管复合材料的研制（No.12511z024），黑龙江省教育厅科学技术研究重点项目，2011.01-2013.12，主持人

8. 贫燃条件下双功能催化剂的研制及机理研究 (No.11511270), 黑龙江省教育厅科学技术研究面上项目, 2006.01-2008.12, 主持人
9. 海伦市东方红水库面源污染治理工程和环境修复研究 (合同编号20073), 黑龙江省嘉然环境监测有限公司, 2020.06-2021.12, 主持人
10. 碳纳米纸现为形貌及热性能研究 (合同编号13049), 哈尔滨工业大学, 2013.09-2014.09, 主持人
11. 石墨化碳-金属 (氧化物) 复合材料的可控制备及应用 (No.216710), 国家自然科学基金项目, 2011/01-2013/12, 第二
- 高度有序碳纳米管阵列膜的模板法合成与表面修饰及气敏 (No.20676027), 国家自然科学基金项目, 2007/01-2009/12, 第二
12. 介孔分子筛模板法合成高度有序碳纳米管阵列膜及气敏性研究 (No.20576027), 国家自然科学基金项目, 2006/01-2006/12, 第二
13. 气候变化背景下多年冻土区六六六 (HCHs) 和多氯联苯 (PCBs) 的二次排放 (No. 21377037), 国家自然科学基金项目, 2014/01-2017/12, 第四
14. 碱性氧化物促进 (类) 钙钛矿复合氧化物中温高效催化分解NO的研究 (No. 20876034), 国家自然科学基金项目, 2009.01-2011.12, 第五
15. 纳米级稀土元素复合氧化物汽车尾气三元催化剂的研究 (黑2004-189), 黑龙江省科技攻关项目, 2005.01-2006.12, 第五

#### 四、发表学术论文情况

1. Mohib Ullah, He Lv, Zhuo Liu, Xue Bai, Junkun Chen, Yang Zhang, Jue Wang, Baihe Sun, Li Li, Keying Shi. Rational fabrication of a g-C<sub>3</sub>N<sub>4</sub>/NiO hierarchical nanocomposite with a large surface area for the effective detection of NO<sub>2</sub> gas at room temperature[J]. *Applied Surface Science*, 2021, 550, 149368(1 of 13).
2. Yanmei Sun, Li Li, Keying Shi. Influence of adsorption small molecules atrazine on nonvolatile resistive switching behavior in Co-Al layered double hydroxide films[J]. *Journal of Materials Science: Materials in Electronics*, 2021, 32(7): 8304-8316.
3. Mohib Ullah, Xue Bai, Junkun Chen, He Lv, Zhuo Liu, Yang Zhang, Jue Wang, Baihe Sun, Li Li, Keying Shi. Metal-organic framework material derived Co<sub>3</sub>O<sub>4</sub> coupled with graphitic carbon nitride as highly sensitive NO<sub>2</sub> gas sensor at room temperature[J]. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 2021, 612, 125972(1 of 12).
4. Yanmei Sun, Li Li, Keying Shi. Analog and Digital Bipolar Resistive Switching in Co-Al-Layered Double Hydroxide Memristor[J]. *Nanomaterials*, 2020, 10(11): 2095(1 of 15).
5. Ye Hong, Di Wang, Chong Lin, Shuiting Luo, Qingjiang Pan, Li Li, Keying Shi. Room-temperature efficient NO<sub>2</sub> gas sensors fabricated by porous 3D flower-like ZnAl-layered double hydroxides[J]. *New Journal of Chemistry*, 2020, 44(42): 18469-18480.
6. Di Wang, Zhi Liu, Ye Hong, Chong Lin, Qingjiang Pan, Li Li, Keying Shi. Controlled preparation of multiple mesoporous CoAl-LDHs nanosheets for the high performance of NO<sub>x</sub> detection at room temperature[J]. *RSC Advances*, 2020, 10(57): 34466-34473.
7. Jialing Xue, Xueyi Zhang, Mohib Ullah, Lang He, Muhammad Ikram, Mawaz Khan, Laifeng Ma, Li Li, Guo Zhang, Keying Shi. Three-dimensional flower-like Ni<sub>9</sub>S<sub>8</sub>/NiAl<sub>2</sub>O<sub>4</sub> nanocomposites composed of ultra-thin porous nanosheets: Fabricated, characterized and ultra-fast NO<sub>x</sub> gas sensors at room temperature[J]. *Journal of Alloys and Compounds*, 2020, 825, 154151(1 of 10).
8. Yang Wang, Jialing Xue, Xueyi Zhang, Jiaqi Si, Yang Liu, Laifeng Ma, Mohib ullah, Muhammad Ikram, Li Li, Keying Shi. Novel intercalated CuO/black phosphorus nanocomposites: Fabrication, characterization and NO<sub>2</sub> gas sensing at room temperature[J]. *Materials Science in Semiconductor Processing*, 2020, 110, 104961(1 of 9).
9. Xueying Zhang, Lei Teng, Yang Liu, Zhi Liu, Jialing Xue, Muhammad Ikram, Mohib ullah, Li Li, Keying Shi. 3D flflower-like NiZnAl multimetal oxide constructed by ultra-thin porous nanosheets: A long-term and stable sensing material for NO<sub>x</sub> at room temperature[J]. *Sensors and Actuators B:Chemical*, 2019, 300: 126899(1 of 11).
10. Xueying Zhang, Muhammad Ikram, Zhi Liu, Lei Teng, Jialing Xue, Di Wang, Li Li, Keying Shi. Expanded graphite/NiAl layered double hydroxide nanowires for ultra-sensitive, ultra-low detection limits and selective NO<sub>x</sub> gas detection at room temperature[J]. *RSC Adv.*, 2019, 9, 8768(1 of 10).
11. Zhi Liu, Lei Teng, Laifeng Ma, Yang Liu, Xueying Zhang, Jialing Xue, Muhammad Ikram, Mohib Ullah, Li Li, Keying Shi. Porous 3D flflower-like CoAl-LDH nanocomposite with excellent performance for NO<sub>2</sub> detection at room temperature[J]. *RSC Adv.* 2019, 9(38): 21911-21921.
12. Jiao Zhou, Muhammad Ikram, Afrasiab Ur Rehman, Jing Wang, Yiming Zhao, Kan Kan, Weijun Zhang, Fazal Raziq, Li Li, Keying Shi. Highly selective detection of NH<sub>3</sub> and H<sub>2</sub>S using the pristine CuO and mesoporous In<sub>2</sub>O<sub>3</sub>@CuO multijunctions nanofibers at room temperature[J]. *Sensors and Actuators B:Chemical*, 2018, 255(2): 1819-1830.
13. Teng Lei, Yang Liu, Muhammad Ikram, Zhi Liu, Mohib Ullah, Laifeng Ma, Xueying Zhang, Hongyuan Wu, Li Li, Keying Shi. One-step synthesis of palladium oxide-functionalized tin dioxide nanotubes: Characterization and high nitrogen dioxide gas sensing performance at room temperature[J]. *Journal of Colloid and Interface Science*, 2018, 537:79-90.
14. Siyu Liu, Lei Teng, Yiming Zhao, Zhi Liu, Jiawei Zhang, Muhammad Ikram, Afrasiab Ur Rehman, Li Li, Keying Shi. Facile route to synthesize porous hierarchical Co<sub>3</sub>O<sub>4</sub>/CuO nanosheets with high porosity and excellent NO<sub>x</sub> sensing properties at room temperature[J]. *Applied Surface Science*, 2018, 450: 91-101.
15. Yiming Zhao, Muhammad Ikram, Jiawei Zhang, Kan Kan, Hongyuan Wu, Wanzhen Song, Li Li, Keying Shi. Outstanding gas sensing performance of CuO-CNTs nanocomposite based on asymmetrical schottky junctions[J]. *Applied Surface Science*, 2018, 428: 415-421.

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17. He Xu, Jiawei Zhang, Afrasiab Ur Rehman, Lihong Gong, Kan Kan, Li Li, Keying Shi. Synthesis of  $\text{NiO}@\text{CuO}$  nanocomposite as high-performance gas sensing material for  $\text{NO}_2$  at room temperature[J]. *Applied Surface Science*, 2017, 412:230-237.
18. Afrasiab Ur Rehman, Jiawei Zhang, Jiao Zhou, Kan Kan, Li Li, Keying Shi. Synthesis of mesoporous  $\text{K}_2\text{O}-\text{In}_2\text{O}_3$  nanowires and  $\text{NO}_x$  gas sensitive performance study in room temperature[J]. *Microporous and Mesoporous Materials*, 2017, 240: 50-56.
19. Hongyuan Wu, Haitao Huang, Jiao Zhou, Dahai Hong, Muhammad Ikra, Afrasiab Ur Rehman, Li Li, Keying Shi. One-step Synthesis of Ordered  $\text{Pd}@\text{TiO}_2$  Nanofibers Array Film as Outstanding  $\text{NH}_3$  Gas Sensor at Room Temperature[J]. *Scientific Reports*, 2017, 7: 14688-14698.
19. Dahai Hong, Jiawei Zhang, Afrasiab Ur Rehman, Lihong Gong, Jiao Zhou, Kan Kan, Li Li, Keying Shi. One-step synthesis of hierarchical Ni-Fe-Al layered double hydroxide with excellent sensing properties for  $\text{NO}_x$  at room temperature[J]. *RSC Adv.*, 2016, 6, 103192-103198.
20. Linlin Wang, Afrasiab Ur Rehman, Hongyuan Wu, Baofeng Wu, Li Li, Keying Shi. Submicrochains composed of massager ball-like  $\text{WO}_3@\text{CuWO}_4$  composites for high-efficiency CO gas sensing applications at room temperature[J]. *RSC Advances*, 2016, 6: 69999-70007.
21. Hongyuan Wu, Linlin Wang, Jiao Zhou, Jun Gao, Guo Zhang, Shuang Xu, Yu Xie, Li Li, Keying Shi. Facile preparation of porous  $\text{In}_2\text{TiO}_5$ -rutile composite nanotubes by electrospinning and sensitivity enhancement in  $\text{NO}_2$  gas at room temperature[J]. *Journal of Colloid & Interface Science*, 2016, 466: 72-79.
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23. Baofeng Wu, Linlin Wang, Hongyuan Wu, Kan Kan, Guo Zhang, Yu Xie, Ye Tian, Li Li, Keying Shi. Templated synthesis of 3D hierarchical porous  $\text{Co}_3\text{O}_4$  materials and their  $\text{NH}_3$  sensor at room temperature[J]. *Microporous and Mesoporous Materials*, 2016, 225: 154-163.
24. Jingchao Wang, Linlin Wang, Jun Gao, Ling Zhou, Yunlong Ge, Liqiang Jing, Keying Shi, Li Li. Detection of  $\text{NO}_x$  down to ppb levels at room temperature based on highly mesoporous hierarchical  $\text{Ni}(\text{OH})_2-\text{In}(\text{OH})_3$  double hydroxide composites[J]. *J Mater Sci: Mater Electron*, 2015, 26: 6612-6624.
25. Hongxin Sun, Zhenyu Chu, Dahai Hong, Guo Zhang, Yu Xie, Li Li, Keying Shi. Three-dimensional hierarchical flower-like Mg-Al-layered double hydroxides: Fabrication, characterization and enhanced sensing properties to  $\text{NO}_x$  at room temperature[J]. *Journal of Alloys and Compounds*, 2015, 658: 561-568.
26. Zhenyu Chu, Hongxin Sun, He Xu, Jiao Zhou, Guo Zhang, Yu Xie, Li Li, Keying Shi. 3D porous  $\alpha\text{-Ni}(\text{OH})_2$  nanostructure interconnected with carbon black as high-performance gas sensing material for  $\text{NO}_2$  at room temperature[J]. *RSC Advances*, 2015, 5: 101760-101767.
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28. Shuang Xu, Jun Gao, Linlin Wang, Kan Kan, Yu Xie, Peikang Shen, Li Li, Keying Shi. Role of the heterojunctions in  $\text{In}_2\text{O}_3$ -composite  $\text{SnO}_2$  nanorod sensors and their remarkable gas-sensing performance for  $\text{NO}_x$  at room temperature[J]. *Nanoscale*, 2015, 7: 14643-14651.
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30. Yu Peishu, Liu Chuntao, Feng Bo, Wan Jiafeng, Li Li, Du Chunyu. Highly efficient anode catalyst with a  $\text{Ni}@\text{PdPt}$  core-shell nanostructure for methanol electrooxidation in alkaline media[J]. *Int. J. Miner. Metall. Mater.*, 2015, 22(10): 1101-1107.
31. Shuang Xu, Kan Kan, Ying Yang, Chao Jiang, Jun Gao, Liqiang Jing, Peikang Shen, Li Li, Keying Shi. Enhanced  $\text{NH}_3$  gas sensing performance based on electrospun alkaline-earth metals composited  $\text{SnO}_2$  nanofibers[J]. *Journal of Alloys and Compounds*, 2014, 618: 240-247.
32. Hongyuan Wu, Kan Kan, Linlin Wang, Guo Zhang, Ying Yang, Hui Li, Liqiang Jing, Peikang Shen, Li Li, Keying Shi. Electrospinning of mesoporous p-type  $\text{In}_2\text{O}_3/\text{TiO}_2$  composite nanofibers for enhancing  $\text{NO}_x$  gas sensing properties at room temperature[J]. *CrystEngComm*, 2014, 16: 9116-9124.
33. Songying Liu, Ling Zhou, Liyuan Yao, Liya Chai, Li Li, Guo Zhang, Kan Kan, Keying Shi. One-pot reflux method synthesis of cobalt hydroxide nanoflake-reduced graphene oxide hybrid and their  $\text{NO}_x$  gas sensors at room temperature[J]. *J. Alloys Compd.*, 2014, 612: 126-133.
34. Lifang Dang; Guo Zhang; Kan Kan; Yufei Lin; Fuquan Bai; Liqiang jing; Peikang Shen; Li Li; Keying Shi. Heterostructured  $\text{Co}_3\text{O}_4/\text{PEI-CNTs}$  Composite: Fabrication, Characterization and CO Gas Sensors at Room Temperature[J]. *J. Mater. Chem. A*, 2014, 2: 4558-4565.
35. Yunlong Ge, Kan Kan, Ying Yang, Ling Zhou, Liqiang Jing, Peikang Shen, Li Li, Keying Shi. Highly mesoporous hierarchical nickel and cobalt double hydroxide composite: fabrication, characterization and ultrafast  $\text{NO}_x$  gas sensors at room temperature[J]. *J. Mater. Chem. A*, 2014, 2: 4961-4969.
36. Jun Gao, Linlin Wang, Kan Kan, Shuang Xu, Liqiang jing, Shiqiang Liu, Peikang Shen, Li Li, Keying Shi. One-step synthesis of mesoporous  $\text{Al}_2\text{O}_3-\text{In}_2\text{O}_3$  nanofibres with remarkable gas-sensing performance to  $\text{NO}_x$

at room temperature[J]. J. Mater. Chem. A, 2014, 2: 949-956.

37. Tiekai Zhao, Lianping Zhang, Li Li, Guo Zhang, Kan Kan, Keying Shi. Synthesis, Characterization and Sensing Properties of ZnO-modified BN-FeB<sub>49</sub>[J]. J. Alloys Compd., 2014, 600: 130-136.

38. Li Li, Guo Zhang, Lei Chen, Hongmei Bi, Keying Shi. Ni(NiO)/single-walled carbon nanotubes composite: synthesis of electro-deposition, gas sensing property for NO gas and density functional theory calculation[J]. Mater. Res. Bull, 2013, 48: 504-511.

39. Guo Zhang, Lifang Dang, Li Li, Ruihong Wang, Honggang Fu, Keying Shi. Design and construction of Co<sub>3</sub>O<sub>4</sub>/PEI-CNTs composite exhibiting fast responding CO sensor at room temperature[J]. CrystEngComm, 2013, 15: 4730-4738.

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41. Lixue Yang, Li Li, Ying Yang, Guo Zhang, Lihong Gong, Liqiang Jing, Honggang Fu, Keying Shi. Facile synthesis of Cu/Cu<sub>x</sub>O nano architectures with adjustable phase composition for effective NO<sub>x</sub> gas sensor at room temperature[J]. Mater. Res. Bull, 2013, 48: 3657-3665.

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#### 五、授权专利情况

1. 李丽, 宋嘉宝, 王婧超, 田野, 史克英. 一种用于检测NO<sub>x</sub>的稀土掺杂改性的石墨烯复合材料气敏元件及其制备方法[P]. 中国专利, 专利号: ZL 2014 1 0363368.4, 授权公告日: 2016.05.11

2. 李丽, 史克英, 张雪影, 洪大海. 一种三维层状NiZnAl半导体多金属氧化物复合材料及其制备方法和应用[P]. 中国专利, 公开号: CN107091863A, 授权公告日: 2019.11.07

3. 史克英, 李丽, 刘思宇. 还原氧化石墨烯-聚乙烯亚胺-四氧化三钴氧化物半导体复合材料及制备方法和应用[P]. 中国专利, 公开号: CN107037085B, 授权公告日: 2019.06.07.

4. 史克英, 李丽, 亢佳萌. 一种二硫化钼/氢氧化镁纳米复合材料及其制备方法和应用[P]. 中国专利, 公开号: CN106596651B, 授权公告日: 2019.02.12.

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#### 六、学术著作情况

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#### 七、其他

**主讲课程:** 环境科学、固体废弃物处理与利用、环境催化与环境材料、催化剂的制备与设计等课程

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