**北京邮电大学**

**科学技术发展研究院**

科研院通【2017】51号



推荐北京市科学技术奖候选项目公示-3

我单位推荐下列项目申报 2017 年度北京市科学技术奖，特进行公示。公示期：2017年3月20日至2017年3月28日，公示期内如对公示内容有异议，请您向 北京邮电大学科研院成果管理办公室 反映。

联系人及电话：刘红 010-62282052

**一、项目名称：**纳米结构材料光电特性与量子光学效应的理论及应用

**二、候选单位：**北京邮电大学

**三、候 选 人：** 1.俞重远；2.刘玉敏；3.叶 寒；4.芦鹏飞；5.韩利红；

6.张 文；7.王东林；8.伍铁生；9.彭益炜；10.马 申

**四、项目简介：**

量子电子学和量子光学效应使得纳米结构材料作为新型微纳器件的基础构件，在纳米电子学、量子信息、生命科学等方面具有极其重要的应用前景和发展空间。长期以来，我们对纳米结构材料光电特性与量子光学效应进行了系统深入的研究。

1.量子点-微腔相互作用：在腔量子电动力学框架内，研究了量子点-双模微腔耦合系统的反常光子阻塞效应，提出了双模泵浦激励模型，并指出利用双模微腔可以实现高性能单光子源。研究了在磁场作用下的量子点与双模微腔耦合系统对脉冲激励的非线性响应、偏振敏感性，可用于光子级光开关和偏振转换。在偏振脉冲激励条件下，基于多路径量子干涉相消，首次实现了极少光子层次的全光逻辑器件。

2.材料生长机制与光电特性：研究了高品质半导体纳米材料的生长机制，提出了基于剩余应变能的全能量平衡判据，定量预测了量子点、纳米线无位错生长的临界尺寸。提出并研究了利用量子点应变场抑制衬底贯穿位错的机理，计算并预测了量子点能够抑制贯穿位错传播的区域。研究了应变、压电、组分分布、缺陷、掺杂、刻蚀等对纳米材料电子结构和光学特性的影响和调制作用；揭示了多元量子点和纳米线内部自发非均匀组分分布的形成物理机制。基于6带K·P理论研究了量子点、量子环的几何参数对基态能量、跃迁能等电子结构的影响。
 3.微纳光学材料结构设计与应用：设计了新型光子带隙结构、光子晶体微腔、光子晶体波导结构，可以用于实现量子点-微腔强耦合系统；设计了用于超慢光传输的能带平坦的光子晶体波导。研究了基于金属表面等离子体波导的温度传感器结构，提出和设计了多种太阳能电池结构。

**五、相关证明材料：**

**代表性论文、著作发表情况（限10篇）**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **序号** | **论文（著作）名称** | **刊名/出版社** | **影响因子** | **发表时间（年月日）** | **通讯作者** | **第一作者** | **论文全部作者** | **SCI他引次数** | **EI他引次数** | **他引总次数** | **年卷期页码** | **是否国内完成** |
| 1 | Optimal photon antibunching in a quantum-dot-bimodal-cavity system | PHYSICAL REVIEW A | 2.765 | 2014.4.21 | Yu,Zhongyuan | Zhang,Wen | Zhang,Wen;Yu,Zhongyuan;Liu,Yumin;Peng,Yiwei | 15 | 1 | 16 | 2014,89(4):043832 | 是 |
| 2 | Low-photon-number optical switch and AND/OR logic gates based on quantum dot-bimodal cavity coupling system  | SCIENTIFIC REPORTS | 5.228 | 2016.1.11 | Yu,Zhongyuan | Ma,Shen | Ma,Shen;Ye,Han;Yu,Zhongyuan;Zhang,Wen;Peng,Yiwei;Cheng,Xiang;Liu,Yumin | 1 | 0 | 1 | 2016,6:19001 | 是 |
| 3 | Critical Thickness and Radius for Axial Heterostructure Nanowires Using Finite-Element Method | NANO LETTERS | 13.779 | 2009.3.30 | Yu,Zhongyuan | Ye,Han | Ye,Han;Lu,Pengfei;Yu,Zhongyuan;Song,Yuxi;Wang,Donglin;Wang,Shumin | 24 | 5 | 29 | 2009,9(5):1921-1925 | 是 |
| 4 | Plastic relaxation of mixed dislocation in axial nanowireheterostructures using Peach-Koehler approach | PHYSICA STATUS SOLIDI-RAPID RESEARCH LETTERS | 2.578 | 2014.4.10 | Ye,Han | Ye,Han | Ye,Han;Yu,Zhongyuan | 1 | 0 | 1 | 2014,8(5):445-448 | 是 |
| 5 | Plastic relaxation and coherency limit in uncapped multi-faceted InAs/GaAs(001) nanoislands | JOURNAL OF APPLIED PHYSICS | 2.101 | 2013.9.3 | Yu,Zhongyuan | Ye,Han | Ye,Han;Yu,Zhongyuan;Lu,Pengfei;Liu,Yumin;Han,Lihong | 2 | 0 | 2 | 2013,114(9):093504 | 是 |
| 6 | Six-band k . p calculation of strained InAs/GaAs quantum rings | SUPERLATTICES AND MICROSTRUCTURES | 2.117 | 2010.4.7 | Yu,Zhongyuan | Jia,Boyong | Jia,Boyong;Yu,Zhongyuan;Liu,Yumin;Wao,Wenjie;Feng,Hao;Ye,Han | 2 | 0 | 2 | 2010,47(6):714-722 | 是 |
| 7 | Linear and nonlinear optical absorption coefficients and refractive index changes in strained GaN/AlN quantum dots | PHYSICA E-LOW-DIMENSIONAL SYSTEMS & NANOSTRUCTURES | 1.904 | 2009.3.19 | Yu,Zhongyuan | Yao,Wenjie | Yao,Wenjie;Yu,Zhongyuan;Liu,Yumin;Jia,Boyong | 25 | 1 | 26 | 2009,41(8):1382-1385 | 是 |
| 8 | The optimal structure of two dimensional photonic crystals with the large absolute band gap | OPTICS EXPRESS | 3.148 | 2011.9.26 | Wang,Donglin | Wang,Donglin | Wang,Donglin;Yu,Zhongyuan;Liu,Yumin;Lu,Pnegfei;Hna,Lihong;Feng,Hao;Guo,Xiaotao;Ye,Han | 4 | 1 | 5 | 2011,19(20):19346-19353 | 是 |
| 9 | The sensing characteristics of plasmonic waveguide with a ring resonator | OPTICS EXPRESS | 3.148 | 2014.4.7 | Liu,Yumin | Wu,Tiesheng | Wu,Tiesheng;Liu,Yumin;Yu,Zhongyuan;Pneg,Yiwei;Shu,Changgan,Ye,Han | 31 | 3 | 34 | 2014,22(7):7669-7677 | 是 |
| 10 | Ultra-compact broadband mode converter and optical diode based on linear rod-type photonic crystal waveguide | OPTICS EXPRESS | 3.148 | 2015.4.20 | Ye,Han | Ye,Han | Ye,Han;Wang,Donglin;Yu,Zhongyuan;Zhang,Jinqiannan;Chen,Zhihui | 3 | 0 | 3 | 2015,23(8):9673-9680 | 是 |

**代表性论文、著作被他人引用情况（限10篇）**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **序号** | **被引代表性论文、著作序号** | **引文名称 / 引文作者** | **刊名 / 影响因子（引文）** | **引文发表时间（年月日）** |
| 1 | Critical Thickness and Radius for Axial Heterostructure Nanowires Using Finite-Element Method | Axial Diffusion Barriers in Near-Infrared Nanopillar LEDs / Scofield, Adam C.;Lin, Andrew;Haddad, Michael;Huffaker, Diana L. | NANO LETTERS / 13.779 | 2014.11 |
| 2 |  Optimal photon antibunching in a quantum-dot-bimodal-cavity system | Quantum Interference Induced Photon Blockade in a Coupled Single Quantum Dot-Cavity System / Tang, Jing; Geng, Weidong; Xu, Xiulai | SCIENTIFIC REPORTS / 5.228 | 2015.3.18 |
| 3 | The sensing characteristics of plasmonic waveguide with a ring resonator | Tunable nanoplasmonic sensor based on the asymmetric degree of Fano resonance in MDM waveguide / Zhan, Shiping; Peng, Yongyi; He, Zhihui; Li, Boxun;Chen, Zhiquan;Xu, Hui;Li, Hongjian | SCIENTIFIC REPORTS / 5.228 | 2016.3.2 |
| 4 | Critical Thickness and Radius for Axial Heterostructure Nanowires Using Finite-Element Method | Inhomogeneous strain in GaN nanowires determined from x-ray diffraction peak profiles / Kaganer, V. M.;Jenichen, B.;Brandt, O.;Fernandez-Garrido, S.;Dogan, P.;Geelhaar, L.;Riechert, H. | PHYSICAL REVIEW B / 3.718 | 2015.9.18 |
| 5 | Six-band k . p calculation of strained InAs/GaAs quantum rings | Hole states in nanocups in a magnetic field / Cukaric, N.; Arsoski, V.; Tadic, M.;Peeters, F. M. | PHYSICAL REVIEW B / 3.718 | 2012.6.12 |
| 6 |  Optimal photon antibunching in a quantum-dot-bimodal-cavity system | Exact optimal control of photon blockade with weakly nonlinear coupled cavities / Shen, H. Z.; Zhou, Y. H.; Liu, H. D.; Wang, G. C.;Yi, X. X. | OPTICS EXPRESS / 3.148 | 2015.12.14 |
| 7 | Plastic relaxation of mixed dislocation in axial nanowireheterostructures using Peach-Koehler approach | Chapter Two – Strain in Nanowires and Nanowire Heterostructures / Glas, Frank;Morral, AFI; Dayeh, SA; Jagadish, C | Semiconductors and Semimetals /专著 | 2015.10.21 |
| 8 | The optimal structure of two dimensional photonic crystals with the large absolute band gap | Bi-directional evolutionary optimization for photonic band gap structures / Meng, Fei; Huang, Xiaodong; Jia, Baohua | JOURNAL OF COMPUTATIONAL PHYSICS / 2.556 | 2015.12.1 |
| 9 | Low-photon-number optical switch and AND/OR logic gates based on quantum dot-bimodal cavity coupling system | 2D photonic crystal logic gates based on self-collimated effect / Fan, Ranran; Yang, Xiulun; Meng, Xiangfeng; Sun, Xiaowen | JOURNAL OF PHYSICS D-APPLIED PHYSICS / 2.772 | 2016.8.17 |
| 10 | Ultra-compact broadband mode converter and optical diode based on linear rod-type photonic crystal waveguide | Tunable spatial mode converters and optical diodes for graphene parallel plate waveguides / Nezhad, Vahid Foroughi; Haddadpour, Ali; Veronis, Georgios | OPTICS EXPRESS / 3.148 | 2016.10.17 |

 公示单位：北京邮电大学

 2017年 3月20日