

## 论文

### 纳米粒子形貌与表面等离子体激元关系

赵炜,赵晓鹏

(西北工业大学 智能材料研究室,西安 710129)

#### 摘要:

通过调控纳米粒子表面形貌,研究了纳米粒子形貌与表面等离子体激元之间的关系.采用水相化学合成法制备出粗糙表面“花朵”形银纳米粒子.通过自组装形成单层阵列,并进一步组装成复合结构超材料.测试了其光学行为,并将实验结果与树枝形纳米粒子、光滑表面纳米粒子进行对比分析.结果表明:光滑表面纳米粒子不能出现超材料效应,当粗糙程度增加,纳米粒子呈类“花朵”形时,样品出现透射峰和平板聚焦行为,但强度不高|当粗糙程度继续增加,纳米粒子呈树枝状时,出现了较强的透射峰与平板聚焦行为.研究证实通过改变纳米粒子表面形貌,可以调控表面等离子体激元与入射光的相互作用,从而实现对光传播的操控.

**关键词:** 超材料 自组装 表面形貌 表面等离子体激元

### Relationship of Surface Plasmon Polaritons and Nanoparticles Morphology

ZHAO Wei,ZHAO Xiao-peng

(Smart Materials Laboratory,Northwestern Polytechnical University,Xi'an 710129,China)

#### Abstract:

The relationship of surface plasmon polaritons and morphology of nanoparticles was researched by tailoring the particle's surface morphology. Roughened silver nanoparticle was prepared by aqueous chemical method and further fabricated into composite structured metamaterial, the optical behavior of as-prepared sample was measured then. The experimental results are contrasted with the one of dendrites and smooth-surface particles. The results show that metamaterials effect does not appear in smooth-surface particles, however, the peculiar effect appears in flower-like particles and dendritic particles with lower and higher intensity, respectively. By altering the structure of a particle's surface, the properties of surface plasmons can be significantly changed, and the manipulation on light propagation can also be realized.

**Keywords:** Metamaterials Self-assemble Surface morphology Surface Plasmon Polaritons

收稿日期 2010-12-08 修回日期 2011-01-13 网络版发布日期 2011-04-25

DOI: 10.3788/gzxb20114004.0556

#### 基金项目:

国家自然科学基金(No.50632030, No.50872113, No.50936002)资助

**通讯作者:** 赵晓鹏(1957-),男,教授,博导,主要研究方向为智能材料与结构、超材料及纳米光电子学. Email: xpzhaow@nwpu.edu.cn

#### 作者简介:

#### 参考文献:

- [1]RITCHIE R H. Plasma losses by fast electrons in thin films[J]. Physical Review, 1957, 106(5): 874-881.
- [2]RAETHER H. Surface Plasmons on smooth and rough surfaces and on gratings[M]. Berlin: Springer-Verlag, 1988: 40-58.
- [3]SHALAEV V M, KAWATA S. Nanophotonics with surface plasmons[M]. Amsterdam: Elsevier, 2007: 273-305.
- [4]LIZ-MARZAN L M. Tailoring surface plasmons through the morphology and assembly of metal nanoparticles[J]. Langmuir, 2006, 22(1): 32-41.

## 扩展功能

### 本文信息

- Supporting info
- PDF(2014KB)
- HTML
- 参考文献

### 服务与反馈

- 把本文推荐给朋友
- 加入我的书架
- 加入引用管理器
- 引用本文
- Email Alert
- 文章反馈
- 浏览反馈信息

### 本文关键词相关文章

- 超材料
- 自组装
- 表面形貌
- 表面等离子体激元

### 本文作者相关文章

- 赵炜
- 赵晓鹏

[5]NOGUEZ C.Surface plasmons on metal nanoparticles: the influence of shape and physical environment[J].The Journal of Physical Chemistry C,2007,111(10): 3806-3819.

[6]ZAYATS A V,SMOLYANINOV I I,MARADUDIN A A.Nano-optics of surface plasmon polaritons [J].Physics Reports,2005,408(3-4): 133-145.

[7]BURDA C,CHEN X B,NARAYANAN R.Chemistry and properties of nanocrystals of different shapesp [J].Chemical Reviews,2005,105(4): 1025-1102.

[8]SOSA I O,NOGUEZ C,BARRERA R G.Optical properties of metal nanoparticles with arbitrary shapes [J].The Journal of Physical Chemistry B,2003,107(26): 6269-6275.

[9]WILEY B,SUN Y,MAYERS B.Shape-controlled synthesis of metal nanostructures: the case of silver [J].Chemistry-A European Journal,2005,11(2): 454-463.

[10]SUN C Q,TAYB K,ZENG X T, et al.Bond-order-bond-length-bond-strength (bond-OLS) correlation mechanism for the shape-and-size dependence of a nanosolid[J].Journal of Physics: Condensed Matter,2002,14(34): 7781-7795.

[11]ZHAO W,ZHAO X P.Fabrication and characterization of metamaterials at optical frequencies [J].Optical Materials,2010,32(3): 422-426.

[12]CHEN H,RAN L,HUANGFU J,et al.Metamaterial exhibiting left-handed properties over multiple frequencybands[J].Journal of Applied Physics,2004,96(9): 5338-5340.

[13]GOLLUB J,HAND T,SAJUJIGBE S,et al.Characterizing the effects of disorder in metamaterial structures[J].Applied Physics Letters,2007,91(16): 162907-162907-3.

[14]LEPETIT T,AKMANSOY E,PATE M,et al.Broadband negative magnetism from all-dielectric metamaterial[J].Electronics Letters,2008,44(19): 1119-1121.

[15]ZHOU X,FU Q F,ZHAO J,et al.Negative permeability and subwavelength focusing of quasi-periodic dendritic cell metamaterials[J].Optics Express,2006,14(16): 7188-7197.

### 本刊中的类似文章

1. 邵淑英; 范正修; 邵建达; 沈卫星; 江敏华.氧分压对电子束蒸发SiO<sub>2</sub>薄膜机械性质和光学性质的影响[J]. 光子学报, 2005,34(5): 742-745
2. 李宇杰 谢凯 许静 韩喻 涂圣义 李运鹏.低压化学气相沉积技术制备锆反蛋白石三维光子晶体[J]. 光子学报, 2009,38(2): 281-284
3. 刘桂强,廖昱博,陈艳,刘忠民.高质量三维光子晶体的实验制备及理论分析[J]. 光子学报, 2009,38(7): 1707-1712
4. 吴雷学,汪韬,王警卫,李晓婷,景争,尹飞,梅书刚.低压MOCVD生长参量对II型InAs/GaSb超晶格材料表面形貌的影响 [J]. 光子学报, 2009,38(8): 1937-1941
5. 张惠芳,赵玉静,陶峰,任海红,王燕,白丽华,戴晔,阎晓娜.五层对称人工超常材料结构的表面等离子体激元[J]. 光子学报, 2010,39(12): 2234-2240

文章评论 (请注意:本站实行文责自负, 请不要发表与学术无关的内容!评论内容不代表本站观点.)

反馈人	<input type="text"/>	邮箱地址	<input type="text"/>
反馈标题	<input type="text"/>	验证码	<input type="text" value="5548"/>
<input type="text"/> 			