

论文

银纳米圆盘光天线的远场方向性研究

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摘要:

采用时域有限差分方法计算了银纳米圆盘天线模型的场分布,研究了光偶极天线的远场辐射特性随距离和厚度、半径变化的规律以及影响其远场方向性的因素. 研究发现,偶极子垂直放置在银纳米圆盘下方一定距离时,银盘厚度和半径的改变均可使方向性图中出现新的辐射模式,同时方向性增益得到增强. 通过对其近场的观察和分析可以得知,新的辐射模式的产生来源于高阶模式的局域表面等离子激元. 结果表明,背景材料为Ga₂N₃时,产生高阶模式局域表面等离子激元的合适条件为电偶极子距银盘底部40 nm. 另外,为了有效地支持高阶模式局域表面等离子激元的形成,银盘厚度与半径最小分别为30 nm和100 nm. 本文的研究对掌握纳米银盘结构的光天线特性及其在光器件中的运用有重要意义.

关键词: 光天线 表面等离子激元 纳米银盘 远场方向性

Far-field Characteristics of Silver Nanodisk Optical Antenna

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Abstract:

The near-field distribution of silver nanodisk optical antenna was calculated with Finite-Difference Time-Domain method. The influence to the far-field characteristics by different parameters such as the distance between nanodisk and dipole, thickness and radius of nanodisk, was discussed. The research demonstrated that when the dipole was placed vertically beneath the nanodisk, the variation of thickness or radius could lead to new radiation mode in the far-field pattern and give rise to the enhancement of directivity gain. Through the observation and analysis to near-field, it could be obtained that the new radiation mode was caused by the high order localized surface plasmon(LSP) mode. The optimization results pointed out that as the background material was set as Ga₂N₃, for the sake of producing high order LSP mode, the suitable distance between nanodisk and dipole was 40 nm. Furthermore, in order to effectively support the high order LSP mode, the thickness and radius of nanodisk were at least 30 nm and 100 nm respectively. These results provided a theoretical reference to master the characteristics of nanodisk optical antenna as well as the practical application in optical devices.

Keywords: Optical antenna Surface plasmon Nanodisk Far-field directivity

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