

论文

不同周期数牛眼结构对基于伪表面等离子激发的太赫兹透射的影响

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摘要:

为研究不同周期数的牛眼结构对太赫兹透射的影响,本文利用微机械加工方法,在铝板上分别制作5个圆环凹槽和15个圆环凹槽两种牛眼结构,并利用时域太赫兹波谱系统,对比了这两种不同周期数的牛眼结构的太赫兹时域信号和频域信号.实验结果显示,0.1~2.7THz宽频太赫兹参考信号可以被两种不同周期数的牛眼结构滤成窄带信号,中心峰值均在约0.53THz处,在该值处,5个圆环凹槽的透射率约为55.7%,15个圆环凹槽的透射率约为68.3%,1THz以上高频信号都被基本滤除,小周期数样品与大周期数样品太赫兹透射谱信号带宽与幅值的差别主要是由于周期性展开不足及边缘泄漏所引起.本文利用伪表面等离子理论解释了滤波效果,并通过有限元方法模拟仿真了宽频太赫兹信号通过不同周期数的牛眼结构后的样品信号,模拟结果与实验结果符合得较好,证实了不同周期数的牛眼结构对太赫兹电磁波的增透效应是不同的.

关键词: 超快光学 牛眼结构 时域太赫兹波谱系统 伪表面等离子 有限元

Comparison on Terahertz Transmission Based on Spoof Surface Plasmon Polaritons Between Bull's Eye Structures with Different Ring Grooves

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Abstract:

To study the effect of different circular groove numbers of bull's eye structures on the enhanced transmission in terahertz region, two bull's eye samples were fabricated with five circular grooves and fifteen circular grooves on aluminum slabs, respectively. Transmitted terahertz signals from two bull's eye samples were obtained by using terahertz time-domain spectroscopy. Experimental results show that for both samples, broad-band terahertz reference signal from 0.1 THz to 2.7 THz was filtered to be narrow-band signal, the center peak was at 0.53 THz, the transmission efficiency can reach 55.7% by five circular grooves and 68.3% by fifteen circular grooves through the center holes respectively. The differences on band widths and amplitudes of transmitted terahertz signals from small sample and big sample with different circular groove numbers come from insufficient periodical extension and leakage from edge of structure. Furthermore, spoof surface plasmon polaritons theory was employed to analyze filter phenomena of transmitted signals from different size bull's eye structures with the help of finite element method. The simulated results agree well with the experimental results, both proved that the circular groove numbers can affect the enhancement of the transmission in terahertz region.

Keywords: Ultrafast optics Bull's eye Terahertz time-domain spectroscopy Spoof surface plasmon polaritons Finite element method

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