

ITO/Ag光子晶体薄膜的制备及性能

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Preparation and properties of ITO/Ag photonic crystal thin films

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摘要

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摘要 考虑材料的电磁屏蔽特性和可见光透过的矛盾,设计了以铝/氧化铟锡(Ag/ITO)为周期的光子晶体薄膜以实现电磁屏蔽和可见光透过的兼容.首先根据电磁屏蔽和可视的双重需求,优化了光子晶体的组份并对其性能进行了研究.接着采用磁控溅射方法制备了以Ag/ITO为周期的光子晶体薄膜,并对光子晶体薄膜的屏蔽和可见光透光率进行了测试和分析.实验结果表明:这种光子晶体薄膜在金属Ag总膜厚大于可见光趋肤深度而远小于微波波段趋肤深度时,在可见光波段的最高透光率高达55%,而在微波频率段的屏蔽性能最高可达65 dB.通过结构设计,使薄膜的可见光透光率曲线与人眼的敏感曲线相吻合.随着每个周期Ag膜层的厚度增加,方阻相应降低,微波屏蔽性能相应提高.随着周期数的增加,薄膜的可见光透光率没有相应降低,屏蔽性能没有相应提高.设计的光子晶体薄膜在30 MHz~18 GHz较宽波段的屏蔽性能均大于40 dB.这种设计方法为材料的电磁屏蔽和可见光透明兼容开辟了一条新的技术途径.

关键词: 光子晶体, 光子晶体薄膜, ITO/Ag薄膜, 电磁屏蔽, 透明金属

Abstract: As the shielding effectiveness and light transmittance of materials are conflict, this paper designs transparent shielding films based on the metallic photonic crystals with a period of Silver/Indium Tin Oxide(Ag/ITO) to realize the compatibility of the shielding effectiveness and the light transmittance. The composition of the photonic crystals was optimized and their properties were researched. Then, ITO/Ag periodic films were prepared by magnetron sputtering. Furthermore, the shielding, transmittance and electric conductivity of different structures were analyzed and tested. It is found that the maximum transmittance of the ITO/Ag periodic films at the visible band is up to 55% when the total thickness of Ag films is far more than optical skin depth and the maximum shielding of the ITO/Ag periodic films at microwave frequencies is up to 65 dB when the total thickness of Ag films is far less than the microwave skin depth. By structure design, the visible light transmittance curve of the samples is coincided with the human eye sensitivity curves. The square resistance decreases with each period of Ag film thickness increasing, correspondingly, the shielding increases. Moreover, the transmittance of the films does not decrease with numbers of periods and the shielding is not obviously changed. It realizes that the shielding is greater than 40 dB in the 30 MHz—18 GHz frequency ranges. The method proposed provides a new compatible approach to electromagnetic shielding and visible light transparent.

Key words: photonic crystal photonic crystal thin film ITO/Ag thin film electromagnetic shielding transparent metal

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