光学精密工程 OPTICS AND PRECISION ENGINEERING
核心期刊
主管：中国科学院
主办：中国科学院长春光学精密机械与物理研究所
中国仪器仪表学会
主编：曹健林

光学精密工程 2012, 20(1) 80-87 ISSN: 1004-924X CN: 22-1198/TH

现代应用光学

高透光率感性网栅膜的电磁屏蔽

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摘要： 在确保制作感性网栅膜后光学窗红外透射率下降小于5%的前提下,研究了影响感性网栅膜电磁屏蔽特性的主要因素。归纳了感性网栅膜红外透射率公式,运用含阻抗边界条件的谱域Galerkin法推导了周期结构金属网栅的电磁场积分方程,用周期矩量法计算出网栅的反射系数及透射系数,进而求出其电磁屏蔽效能;计算并分析了采用不同线宽、周期、衬底材料、衬底厚度时透明导电光窗(金属网栅膜)的电磁屏蔽效能。最后,采用激光直写、真空镀膜等工艺在ZnS基底上制作了周期为360 μm×360 μm、线宽为12 μm,方块电阻分别为13 Ω、25 Ω的样片,采用自由空间法测试了2~18 GHz频段的电磁屏蔽效能。测试与分析结果表明:当感性网栅膜在8~10 μm波段引起的平均透射率下降小于2%的情况下,电磁屏蔽效能平均达到了20 dB以上。结果显示网栅的光电特性是矛盾的,线宽与周期越小电磁屏蔽效果越好,同时应尽量降低网栅的表面电阻。

关键词： 高透射率网栅膜 感性网栅膜 电磁屏蔽 矩量法

Electromagnetic shielding of highly transparent inductive mesh

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Abstract: This paper studies the influencing factors on the electromagnetic shielding of an inductive metallic mesh when the infrared transmission reduction of optical window caused by the mesh is less than 5%. The infrared transmission formulas of the inductive mesh are summarized, then, the electromagnetic field integral equation for the periodic structure of metallic mesh is built based on Galerkin's method in the spectral domain. The transmission and reflection coefficients are derived by the Moment of Method(MOM). After that, the electromagnetic shield effectiveness of the mesh is calculated and the effects of different line widths, periods, substrate materials, substrate thicknesses on the electromagnetic shielding of the transparent conductive optical window (with metallic mesh) are calculated and analyzed. Finally, metallic mesh samples with a line width of 12 μm, a period of 360 μm×360 μm and the surface resistance of 13 Ω,25 Ω are fabricated on a ZnS substrate by the laser direct writing figure, vacuum coating, *et al*.. The electromagnetic shield effectiveness from 2 GHz to 18 GHz is tested by a free space method. Results indicate that the average electromagnetic shield effectiveness is more than 20 dB when the infrared transmission reduction caused by the metallic mesh is less than 2% in 8-10 μm. Experiments indicate that the optical and electrical performance of metallic mesh film is inconsistent .The main solution method is to select a thinner line width and smaller period and to reduce the surface resistance value of the mesh as low as possible at the same time.

Keywords: highly transparent mesh inductive mesh electromagnetic shielding Moment of Method (MOM)

收稿日期 2011-11-08 修回日期 2011-12-15 网络版发布日期 2012-01-25

基金项目:

国防科技预研基金资助项目(No.10.4.2.ZK1001)

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