Research on Grating Surface Microstructure for the Chromatic Aberration Compensation in Infrared Band

Jun Wang, Yanjun Sun, Xuesong Ji, Li Wang, Yue Wang, Zhe Li

PII: S1350-4495(18)30155-5
DOI: https://doi.org/10.1016/j.infrared.2018.05.027
Reference: INFPHY 2578

To appear in: *Infrared Physics & Technology*

Received Date: 8 March 2018
Revised Date: 20 May 2018
Accepted Date: 29 May 2018

Please cite this article as: J. Wang, Y. Sun, X. Ji, L. Wang, Y. Wang, Z. Li, Research on Grating Surface Microstructure for the Chromatic Aberration Compensation in Infrared Band, *Infrared Physics & Technology* (2018), doi: https://doi.org/10.1016/j.infrared.2018.05.027

Research on Grating Surface Microstructure for the Chromatic Aberration Compensation in Infrared Band

JunWang[1] , YanjunSun[1*] , XuesongJi[2] , LiWang[1] , YueWang[1]&ZheLi[1]

1*The School of photo-electronic engineering, Changchun University of Science and Technology, Changchun, Jilin,* 130022*, China*

2*Liaoshen Industrial Group Co., Ltd., Shenyang, Liaoning,* 110045*, China*

Abstract: At present, there are problems of large wavelength span and large system volume for the chromatic aberration correction in the infrared band, which is harmful to the miniaturization of the optical system, while, there are problems of low design freedom and low selectivity for the optical material. We designed a grating surface microstructure for infrared chromatic aberration correction. By analyzing the chromatic aberration correction of two common infrared wavebands of 4.8μm and 10.6μm, we focused on grating microstructure design. Taking the infrared chromatic aberration of the ZnSe lens as an example, the scattering surfaces of the two kinds of grating cell structures were simulated by FDTD method. The simulation results show that the single square cylinder grating microstructure performed a phase retardation of 1.4π at 4.8μm and 0.7π at 10.6μm, as a result the compensation effect was not good. While, the phase retardation of double square cylinders grating microstructure at 4.8μm was 1.5π, and the all-phase modulation for range of 0~2π at 10.6μm waveband had been achieved, which is suitable for infrared chromatic aberration compensation. The geometric parameters of the double square cylinders microstructure were designed to be L_1=400nm, L_2=950nm and K=500nm. Fabricate double square cylinders grating microstructure sample on the germanium substrate by the standard semiconductor fabrication technology. Profiler tested the structure parameters, and the results were shown as: L_1=408nm, L_2=944nm, and the height of the square cylinder is K=495.32nm, surface roughness is 16.32nm; the peak transmissivities of two infrared bands for 4.7~4.9μm and 10.5~10.7μm were reached 65% and 62%; the test light path of longitudinal chromatic aberration was established by using the principle of parallel light measuring longitudinal chromatic aberration. After adding sample, the longitudinal chromatic aberration for the infrared waves were reduced by 55%, which proved the effect of the micro-nano structure device on the chromatic aberration correction in infrared band. Compared with traditional lens gluing and other technologies, this technology has the advantages of light weight, small size, high design freedom and good effect on chromatic aberration correction.

Keywords grating microstructure; infrared; chromatic aberration compensation; optics at surface

Introduction

The modulation of light by optical components is reflected in both angle and distance between optical components. The traditional optical design relies heavily on the surface type, the thickness and the material of optical components, resulting in the low design freedom [1], large system volume, heavy weight and other issues, i.e., the low selectivity for the optical material and the energy absorption of the optical glue [2], which is harmful to the miniaturization of optical