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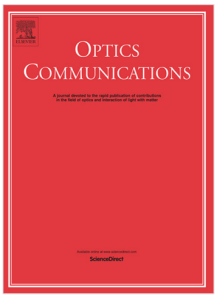

Angle-tolerant hybrid plasmonic blue filter with polarization-insensitivity and high transmission

Qixia Wang, Zhendong Zhu, Huarong Gu, Qiaofeng Tan

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Angle-tolerant hybrid plasmonic blue filter with polarization-insensitivity and high transmission

Qixia Wang [a], Zhendong Zhu [b], Huarong Gu [a,*], Qiaofeng Tan [a,*]

[a] *State Key Laboratory of Precision Measurement Technology and Instruments, Department of Precision Instrument, Tsinghua University, Beijing 100084, China*
[b] *National Institute of Metrology, Beijing, 100018, China*
[*] *ghr@mail.tsinghua.edu.cn; tanqf@mail.tsinghua.edu.cn*

Abstract: The optical blue filter with the suitable bandwidth, high transmittance and large acceptance angle is usually regarded as a critical optical component for a variety of applications. Here, we propose a polarization-insensitive angle-tolerant hybrid plasmonic blue filter incorporating two-dimensional aluminum (Al) nanodisks on the top of planar waveguide. The proposed plasmonic filter works via hybridization of surface plasmon polariton (SPP) mode, the localized Fabry-Perot resonance and waveguide mode, thus enables high peak transmittance up to 70% with the bandwidth of 30 nm and large acceptance angle up to 20°.

Key words: Wavelength filtering devices; Polarization-insensitivity; Large acceptance angle; Plasmonic filter; Waveguide; Light-emitting diode;

1. Introduction

Color filters in the visible region have been shown to be versatile elements in a variety of applications including liquid crystal displays, light-emitting diodes (LED), multi-spectral sensors, and visible light communications (VLC) [1-4]. Moreover, a polarization-insensitive optical blue filter with the suitable bandwidth, high transmittance and large acceptance angle is critical in VLC system [2] to increase the LED modulation bandwidth and the endoscopic capsules [3, 4] to improve the contrast of the images. The transmission spectra of the blue filter should have a strong transmission peak in the range of 400-480nm with typical bandwidth of 30 nm and wide rejection bands at the other range of visible light. In addition, a large acceptance angle is also demanded due to the divergence of the incident beam.

The plasmonic color filter based on extraordinary optical transmission in a nanostructured opaque film has been demonstrated [5-8]. However due to the metal loss, these filters suffer from low peak transmittance or wide transmission bandwidth. One way to solve this issue is to introduce the mode hybridization [9-16]. Yash *et* al [12] demonstrated a novel polarization insensitivity filter with the line width of 79 nm and the transmission efficiency of 40% due to the interaction between the Fano resonance and the extraordinary optical transmission (EOT). Sang-Shin Lee *et* al [13] and L. Jay Guo *et* al [14] proposed the filter with high peak transmittance and modulated bandwidth realized by the hybridization between a plasmonic mode and a waveguide mode. The multi-band transmission color filter with a suitable bandwidth and high peak transmittance was designed based on the mode hybridization [15-16]. Nevertheless, the angular tolerance of these color filters was not discussed in most of the works.

The angle-tolerant hybrid plasmonic filter for both transverse electric (TE) and transverse magnetic (TM) polarized light based on the metal-dielectric-metal Fabry-Perot cavity was proposed [17-22]. However, the bandwidth is broad and extreme precise thickness and refractive indices are necessary for the deposition of the multilayer films. Romain and Salim [23] demonstrated that the cross-holes nanostructured metallic filter can be made angle-insensitive when the shape factor is 0.4, but the bandwidth is as broad as 200nm and the peak transmission is 40%.