Wavelength Plasmonic Demultiplexer Based on Square-disk Resonators in MIM Waveguide

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Abstract

A plasmonic demultiplexer based on cascading square nanodisk resonators in a metal-insulator-metal (MIM) plasmonic waveguide is proposed in this paper. The basic structure of the proposed demultiplexer is a plasmonic filter which consists of two waveguides, a middle cavity and two square nanodisk resonators. According to the simulation results the transmission spectra Full Width at Half-Maximum (FWHM) in the proposed structure reaches about 10 nm. With appropriate choice of refractive index (RI) and geometrical parameters the proposed structure can be adjusted and modified. The proposed structure has low FWHM, high sensitivity and acceptable figure of merit (FoM). By putting three filters with the same dimensions together, a triple-channel demultiplexer with three different wavelengths in each of the channels is designed. The effect of cross talk in the designed demultiplexer is less than -25 dB. The proposed structure can be used in the large-scale photonic integration, ultra-compact demultiplexer devices, nanosensors, integrated plasmonic devices and the development of optical integrated circuits. These structures numerically studied using Finite-Difference Time-Domain (FDTD) simulations.

Full Text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

Schematic of proposed base filter (a) the filter 2-D schematic with $L = 450$ nm, $L' = 460$ nm, $w = 50$ nm, $d_1 = d_4 = 10$ nm, $d_2 = d_3 = 8$ nm, (air) $n = 1.0$ and (b) the filter 3-D schematic

Figure 2

Transmission spectra of proposed filter along with field distribution (a) The filter Transmission spectra (b) The profiles of field $|H_z|$ for $\lambda = 1149 \text{ nm}$

(a)

(b)

(c)

Figure 3

(a) The proposed transmission spectra curve for different refractive index (b) The proposed filter transmission spectra curve for different square nanodisk resonators widths (c) The proposed filter transmission spectra curve for different square nanodisk resonators widths.

Figure 4

(a) Transmission wavelength changes relative to refractive index (b) Transmission wavelength changes with respect to different Length for square nanodisk resonators (c) Transmission wavelength changes with respect to different widths for square nanodisk resonators

Figure 5

Transmission spectra for the proposed filter in different metal areas

Figure 6

Schematic of triple-channel plasmonic demultiplexer with two nanodisk resonators

Figure 7

(a) Transmission spectra with triple -channel output. The profiles of field $|H_z|$ for proposed structure in different wavelengths (b) at $\lambda_1 = 1130$ nm, (c) at $\lambda_2 = 1149$ and (d) at $\lambda_3 = 1168$