

Wavelength Selective Nanophotonic Components Utilizing Channel Plasmon Polaritons

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Channel plasmon polaritons (CPPs) are electromagnetic waves that are bound to and propagate along the bottom of grooves cut into a metal.¹ They are expected to exhibit useful subwavelength confinement, relatively low propagation loss, and single mode operation^{1, 2} as well as efficient transmission around sharp bends.³ Our previous experiments showed that the CPPs at telecom wavelengths propagate over tens of micrometers along grooves in gold and exhibit strong subwavelength confinement⁴ along with low bend losses in large-angle S-bends and Y-splitters,⁵ thereby enabling the realization of ultracompact plasmonic components, such as Mach-Zehnder interferometers and waveguide-ring (WR) resonators.⁶ The results obtained with the above set of structures encouraged us to further exploit the potential of CPPs and to investigate more sophisticated and/or new functional plasmonic components. Here, we report the fabrication and investigation of CPP-based wavelength selective components operating at telecom wavelengths: a WR resonator-based add-drop multiplexer (WRR-ADM) composed of two 0.5- μm -wide and 1.3- μm -deep gold grooves combined with a 5- μm -radius ring resonator and a compact (3.75- μm -long) Bragg grating filter (BGF) comprised 0.5- μm -long wells milled with the period of 0.75 μm across a groove. High quality SNOM images of the components have been obtained in the wavelength range of 1425-1600 nm and analyzed to determine their characteristics.

(1) Novikov, I. V.; Maradudin, A. A. *Phys. Rev. B* **2002**, 66, 035403.

(2) Moreno, E.; Garcia-Vidal, F. J.; Rodrigo, S. G.; Martin-Moreno, L.; Bozhevolnyi, S. I. *Opt. Lett.* **2006**, 23, 3447.

(3) Pile, D. F. P.; Gramotnev, D. K. *Opt. Lett.* 2005, 30, 1186.

(4) Bozhevolnyi, S. I.; Volkov, V. S.; Devaux, E.; Ebbesen, T. W. *Phys. Rev. Lett.* **2005**, 95, 046802.

(5) Volkov, V. S.; Bozhevolnyi, S. I.; Devaux, E.; Ebbesen, T. W. *Appl. Phys. Lett.* **2006**, 89, 143108.

(6) Bozhevolnyi, S. I.; Volkov, V. S.; Devaux, E.; Laluet, J.-Y.; Ebbesen, T. W. *Nature* **2006**, 440, 508.