 Proceedings of ICCES'08, pp.1287-1287

# Subwavelength Plasmonic Devices for Guiding and Concentrating Light

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Here we introduce a gain-assisted switch for plasmonic slot waveguides, and investigate the crosstalk between such waveguides.

We first demonstrate that optical gain provides a mechanism for on/off switching in metal-dielectric-metal (MDM) plasmonic waveguides. The proposed gain-assisted plasmonic switch consists of a subwavelength MDM plasmonic waveguide side-coupled to a cavity filled with semiconductor material. In the absence of optical gain in the semiconductor material filling the cavity, an incident optical wave in the plasmonic waveguide remains essentially undisturbed by the presence of the cavity. Thus, there is almost complete transmission of the incident optical wave through the plasmonic waveguide. In contrast, in the presence of optical gain in the semiconductor material filling the cavity, the incident optical wave is completely reflected.

We also investigate in detail the crosstalk between plasmonic slot waveguides. We show that the coupling behavior of deep subwavelength 3-D plasmonic slot waveguides is very different from the one of 2-D MDM plasmonic waveguides. While in the 2-D case the coupling occurs only through the metal, in the 3-D case the coupling occurs primarily through the dielectric, in which the evanescent tail is much larger compared to the one in the metal. Thus, in most cases the coupling between 3-D plasmonic slot waveguides is much stronger than the coupling between the corresponding 2-D MDM plasmonic waveguides. Such strong coupling can be exploited to form directional couplers using plasmonic slot waveguides. On the other hand, with appropriate design, the crosstalk between 3-D plasmonic slot waveguides can be reduced even below the crosstalk levels of 2-D MDM plasmonic waveguides, without significantly affecting their modal size and attenuation length. Thus, 3-D plasmonic slot waveguides can be used for ultradense integration of optoelectronic components.