Abstracts

Analysis of a Tunable Single Mode Optical Fiber Coupler

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We report the operation and the theoretical modeling of an efficient, tunable, and low-loss single mode fiber coupler. The coupler design follows a scheme previously reported, in which two optical fibers mounted in curved grooves in separate quartz substrates are polished until sufficient cladding material has been removed to permit optical coupling between the mated polished faces of the fibers. The results of a computer analysis of the distributed coupling taking place between the fibers are discussed, emphasizing the intuitive dependence of the coupling coefficient and effective interaction length of the device on its geometrical parameters. A detailed experimental analysis of fiber couplers follows in which we characterize two types of couplers made with different brands of single-mode fibers. Operation up to 100 percent coupling ratio and 50 dB extinction ratio between coupled and direct branch as well as operation in overcoupling regimes are demonstrated, both at visible and infrared signal wavelengths. Tuning curves are shown that emphasize the excellent tunability properties of such couplers in which the coupling ratio can be smoothly and continuously tuned between 0 and 100 percent. Experimental evidence of the relatively low loss level and very low polarization dependence of the fiber couplers are also presented. All experimental results, including an analysis of the influence of the refractive index of the intermediate layer of index-matching liquid between the polished faces of the fibers, are found to be very well predicted by our theoretical model.

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