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High-efficiency optical coupling to planar photodiode using metal reflector loaded waveguide grating coupler

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Abstract For the realization of optoelectronic integrated circuits, it is required to incident light perpendicularly to a planar Si photodiode. We propose a high-efficient vertical optical coupler using an amorphous Si optical waveguide grating coupler with top reflector, which is transparent at 850 nm wavelength range. The optical waveguide (width of 300 nm × height of 100 nm) coupler is analyzed by using finite element method. The coupling efficiency of 80 % is calculated at the grating period of 380 nm, the duty ratio of 0.75 and the depth of 35–65 nm with top metal reflector.

Keywords OEIC · Silicon optical waveguide · Grating coupler · Numerical simulation

1 Introduction

Recently, the operating speed of large-scale integrated (LSI) circuits is approaching a limit because global electrical inter-connection is becoming bottleneck. An optical interconnection instead of traditional electrical interconnection on LSI is proposed to solve this problem (Davis and Meindl 2003; Miller 2000, 2009). Especially, a crystalline silicon (c-Si) optical waveguide have been studied intensively for optical interconnection at the 1.55 μm-wavelength range. The active device at this wavelength needs to introduce compound semiconductor such as GaInAs and AlInAs on c-Si substrate. These materials were difficult to grow epitaxially on Si substrate because of the lattice mismatch. A wafer bonding technique as one of the approaches to integrate on Si-LSI was reported (Fang et al. 2006; Campenhout et al. 2007; Jiang and Bowers 2009; Arai et al. 2011).

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