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Modeling reflections induced by waveguide transitions

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Abstract Reflections generated along optical waveguides may result in detrimental effects and deterioration of the circuit performances. In this work we propose a fast and accurate circuit model to predict the reflection induced by a waveguide discontinuity. The model is based on a variational approach of the Fresnel expression of the reflectivity. After theoretical description, the model is applied to two different interfaces: a waveguide transition inducing very low reflections and a reflective chip facet. A comparison with experimental results and electromagnetic simulations is shown, demonstrating the accuracy of the proposed method.

Keywords Photonics Integration · Numerical Method · Reflection · Waveguides · Discontinuities

1 Introduction

In the development of photonic integrated circuits one of the most important problems to deal with is the generation of spurious lumped or distributed reflections inside the circuit, which may result in detrimental effects and deterioration of the circuit performances. Recent works have demonstrated that distributed backscattering phenomena, arising from random waveguide wall perturbations and surface imperfections, can lead to coupling between propagating and counter-propagating modes (Poulton et al. 2006). This effect is particularly harmful with high-index-contrast technology (e.g. Silicon-On-Insulator technology) where a few hundreds microns long waveguide can produce a level of backscattered power which may prevent its employment in practical applications (Morichetti et al. 2010a).

In the same way, lumped reflections, generated by sharp discontinuities along the waveguide, can greatly affect the whole circuit response both with passive and, in particular, active devices which may amplify the back reflected power and magnify the generated spurious effects. This is the case, for example, of chip integrated light sources for which also very

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