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Design and simulation of broadband multi-layered reflection diffraction grating for using in the silicon solar cells

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ABSTRACT— In this paper, we have performed mathematical analysis of diffraction grating. To prove diffraction, we have used Fourier method that used for the analysis of periodic structures. Then some simulations have performed for different value of design parameters. The results showed that this diffraction grating create an excellent reflection at a broadband when it has been used as the back layer in a silicon solar cell. Furthermore, to have the best diffractive structure, we have scanned reflectance according to the grating parameters. The results of simulation show, when we consider optimal value for design parameter (λ_b , d), the maximum reflectivity of about 97.11% is obtained for the structure.

KEYWORDS: broadband, diffraction grating, reflection, solar cell.

I. INTRODUCTION

Diffraction gratings have played important roles in the knowledge of optics and photonics at the atomic and molecular scale and large scale. Applications of these instruments in science and technology have greatly increased. Among the new applications, a large part lies on the extraordinary scattering properties, the so-called diffraction. The desire to use and control photons in a manner analogous to the control of electrons in solids has inspired great interest in such topics as the localization of light, and light trapping[1]. Diffraction gratings generally have strong variations of grating efficiencies or grating reflections, generated by small variations of incidence or wavelength[2]. Reflection phenomena have led to very interesting practical applications. Diffraction gratings studied in this paper, is similar to what is seen in distributed Bragg reflector(DBR)[3],[4]. So, it is a good reflector for waves that are in the desired frequency band. These conditions have led to strong local enhancements of the field on the grating surface. On the other hand, wideband reflection can be applied for making excellent reflector for efficient photovoltaic cells. The common approach to the design of a grating component is to use dielectric materials. We have employed a new structure to exploit total internal reflection from dielectric interfaces. Considering the maturity of NANO Photonics, various kinds of advanced light trapping techniques may be considered to achieve this goal[5],[6]. In particular, diffraction gratings present a great potential in this field as they can be used either as advanced back reflectors to increase both the path length and the