An RCE based NIR PD using a resonant cavity with dual grating mirrors

M. Zohar[a], Z. Fradkin[a], M. Auslender[b], S. Hava[b]

[a]Sami Shamoon College of Engineering, Department of Electrical and Electronics Engineering, 950, Beer Sheva, 84100 Israel
[b]Ben-Gurion University of the Negev, Department of Electrical Engineering, 653 Beer Sheva 84105 Israel
moshezo@ac.sce.ac.il

Abstract

Two grating mirror structures are considered for a dielectric Fabry Perot cavity within Resonant Cavity Enhanced (RCE) Near Infrared (NIR) photodetector to enhance the optical absorption in a thin semiconductor layer embedded within the cavity [1-2]. In this design, the front and back mirrors are gratings structures with Pitches comparable to subwavelength dimensions, which act as nearly perfect retroreflectors. Semi-analytical calculations, computer aided design and simulations were performed for application in a NIR wavelength band, based on a Si absorbing layer. The results indicate that this new type of cavity meets the combined challenges of significantly increasing the absorption efficiency and reducing the overall complexity of the entire device, when compared to a conventional resonant cavity, in which both mirrors are formed from quarter-wavelength multilayer stacks (DBR mirrors).

The results obtained for the graph and structures shown below:

Structure Type	t_{gB}	d_b	t_a	d_f	d_{Si3N4}	t_{gF}	Λ	W	Absorbance $A(\lambda_0)$ peak	Structure Thickness
RCE-1	-	0.069	**0.150**	0.030	-	-	-	-	**0.529**	3.065
2G-RCE-TE-1	0.120	0.130	**0.150**	1.710	0.792	0.305	0.439	0.252	**0.999**	3.307

References

[1] M. Zohar, M. Auslender and S. Hava, *Nanoscale*, **12** (2015) pp. 5476-5479.
[2] M. S. Ünlü and S. Strite, *J. Appl. Phys.*, **2** (1995) pp. 607–639.

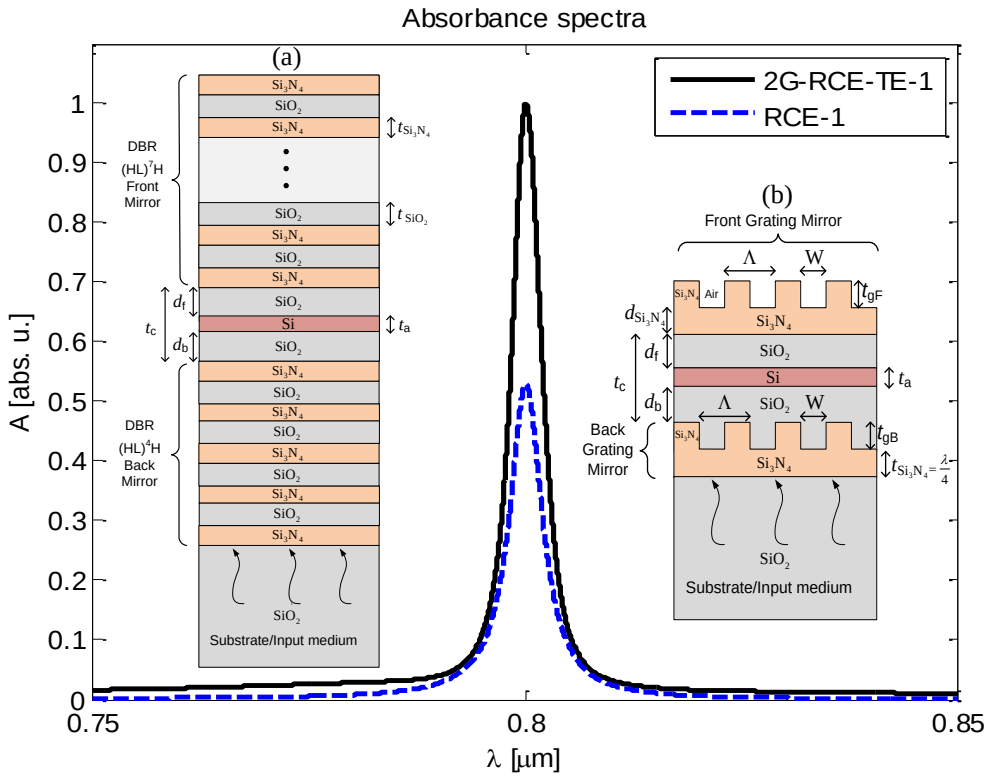

Figure 1: The scheme describes the RCE detector structure of (a) conventional structure designed to operate in the NIR range; (b) RCE detector structure with two Si_3N_4 based grating mirrors in place of the DBR mirrors. The full line represents the absorption spectrum of an optimized conventional detector design RCE-1; the dashed line represents the absorption spectrum of our proposed structure 2G-RCE-TE-1, both structures having an active layer thickness of 150 nm (λ_0 = 0.8 μm).