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SCATTERING PARAMETERS OF OPTICAL FILTERS ON WHISPERING GALLERY MODE MICRORESONATORS FOR INTERLEAVERS BUILDING

Trubin A. A.
National Technical University of Ukraine "Kyiv Polytechnic Institute"
E-mail: atrubin9@gmail.com

ПАРАМЕТРИ РОЗСІЮВАННЯ ОПТИЧНИХ ФІЛЬТРІВ НА МІКРОРЕЗОНАТОРАХ З КОЛИВАННЯМИ ШЕПОЧУЧЕЙ ГАЛЕРЕЇ ДЛЯ ПОБУДОВИ ІНТЕРЛІВЕРІВ

Вперше розглядуються характеристики розсіювання відомих оптичних фільтрів, побудованих на Діелектричних Резонаторах (ДР) з коливаннями шепочучей галереї з урахуванням вищих та нижчих смуг частот, обумовлених іншими коливаннями резонаторів.

Досліджуються вплив різних коливань резонаторів на параметри розсіювання фільтрів з багато смуговими характеристиками. Отримані закономірності добре узгоджуються з результатами інших публікацій, отриманих на основі застосування чисельних методів та експериментальних досліджень. Представлені методики є основою для моделювання і побудови широкого класу інтерліверів сучасних систем оптичного зв'язку.

Dielectric microresonators with whispering gallery modes (WGM) have a quasi-periodic frequency spectrum, which makes them convenient for use in interleavers optical wavelength ranges. [1 - 15].

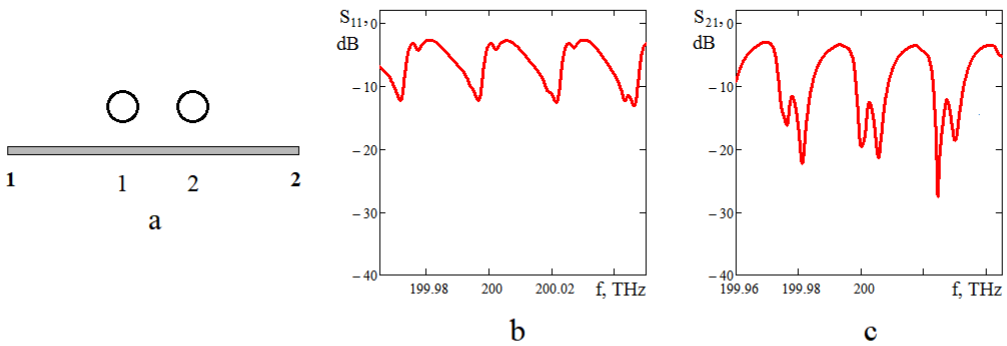

Fig. 1. Scattering characteristics (b - e) of two DR in a transmission line (a) calculated for seven oscillations of degenerate WGM: $f_0 = 200\,\text{THz}$; $FSR = 25\,\text{GHz}$; DR coupling coefficients with a transmission line: for even mode: $\tilde{k}_s^e = 3\cdot 10^{-5}$; for odd mode: $\tilde{k}_s^o = 5\cdot 10^{-6}$; coupling coefficients of the DRs with open space: $\tilde{k} = 10^{-7}$; mutual coupling coefficients between DRs: for even mode: $k_{12}^e = -6{,}5\cdot 10^{-5}$; for odd mode: $k_{12}^o = 2\cdot 10^{-5}$; dielectric loss Q-factor $Q^D = 10^5$. Relative distance between resonators $\Gamma\Delta z_{1,2} = 31\pi/2$ (Γ is a waveguide wave number).

This paper presents new results of modeling the scattering characteristics of transmission line waves on DRs with WGM built on the basis of previously conducted theoretical studies [16 - 17]. For the first time, S-matrices of notch (Fig. 1) and different Add/Drop (Fig. 2, 3) filters are investigated taking into account several types of oscillations.

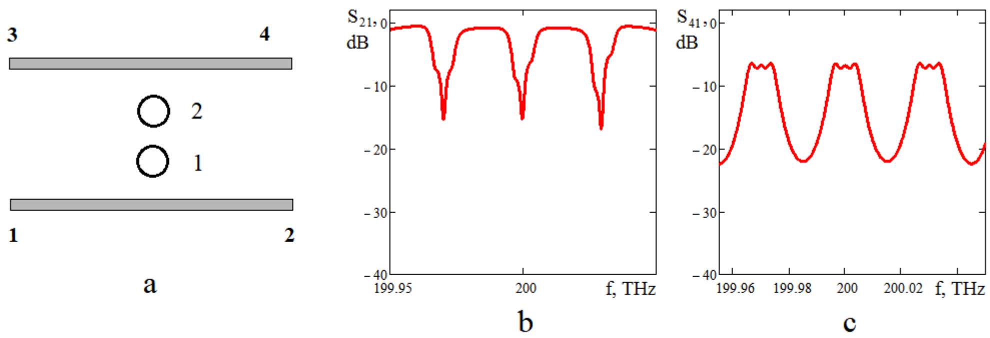

Fig. 2. Scattering characteristics (b - f) of two DR Add/Drop Filter (a) calculated for seven oscillations of degenerate WGM: $f_0 = 200\,\text{THz}$; $FSR = 25\,\text{GHz}$; DR coupling coefficients with a transmission line: for even mode: $\tilde{k}_s^e = 2 \cdot 10^{-5}$; for odd mode: $\tilde{k}_s^o = 2 \cdot 10^{-5}$; with open space: $\tilde{k} = 10^{-7}$; coupling coefficients between DRs: for even mode: $k_{12}^e = 4 \cdot 10^{-5}$; for odd mode: $k_{12}^o = -2 \cdot 10^{-6}$; dielectric loss Q-factor $\mathrm{Q^D} = 10^6$.

For the ferst time showed the possibility of constructing electrodynamics models of filters with periodic scattering characteristics.

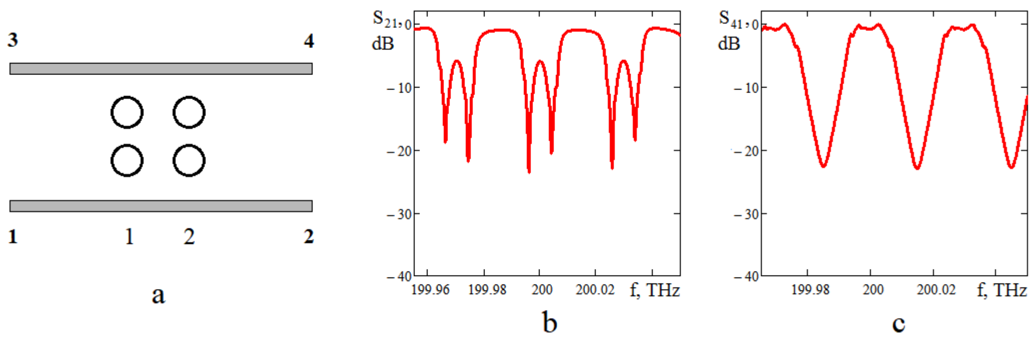

Fig. 3. Scattering characteristics (b - e) of 4 DR Twisted double-channel SCISSOR (a) calculated for seven oscillations of degenerate WGM: $f_0 = 200\,\text{THz}$; $FSR = 30\,\text{GHz}$; DR coupling coefficients with a transmission line: for even mode: $\tilde{k}_s^e = 1{,}2 \cdot 10^{-5}$; for odd mode: $\tilde{k}_s^o = 1{,}2 \cdot 10^{-5}$; coupling coefficients of the DRs with open space: $\tilde{k} = 10^{-8}$; coupling coefficients between DRs: for even mode: $k_{12}^e = 1 \cdot 10^{-6}$; for odd mode: $k_{12}^o = -1 \cdot 10^{-6}$; coupling coefficients between "vertically-coupled" DRs: for even mode: $k_{12}^{eV} = 6 \cdot 10^{-5}$; for odd mode: $k_{12}^{oV} = -3{,}5 \cdot 10^{-5}$; dielectric loss Q-factor $\mathrm{Q^D} = 10^6$.

Presented electrodynamics' model allows to significantly accelerate the design and optimization of scattering characteristics of modern optical communication systems using interleavers in technology WDM.

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