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Design considerations for quasi-phase-matching in doubly resonant lithium niobate hexagonal microresonators

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ABSTRACT:

Fabrication capabilities of high optical quality hexagonal superstructures by chemical etching of inverted ferroelectric domains in lithium niobate platform suggests a route for efficient implementation of compact hexagonal microcavities. Such nonlinear optical hexagonal micro-resonators are proposed as a platform for second harmonic generation (SHG) by the combined mechanisms of total internal reflection (TIR) and quasi-phase-matching (QPM). The proposed scheme for SHG via TIR-QPM in a hexagonal microcavity can improve the efficiency and also the compactness of SHG devices compared to traditional linear-type based devices. A simple theoretical model based on six-bounce trajectory and phase matching conditions was capable for obtaining the optimal cavity size. Furthermore numerical simulation results based on finite difference time domain beam propagation method analysis confirmed the solutions obtained by demonstrating resonant operation of the microcavity for the second harmonic wave produced by TIR-QPM. Design aspects, optimization issues and characteristics of the proposed nonlinear device are presented.