Design and Simulation of GeSbS-Based Microcavities for Advanced Nonlinear Photonics

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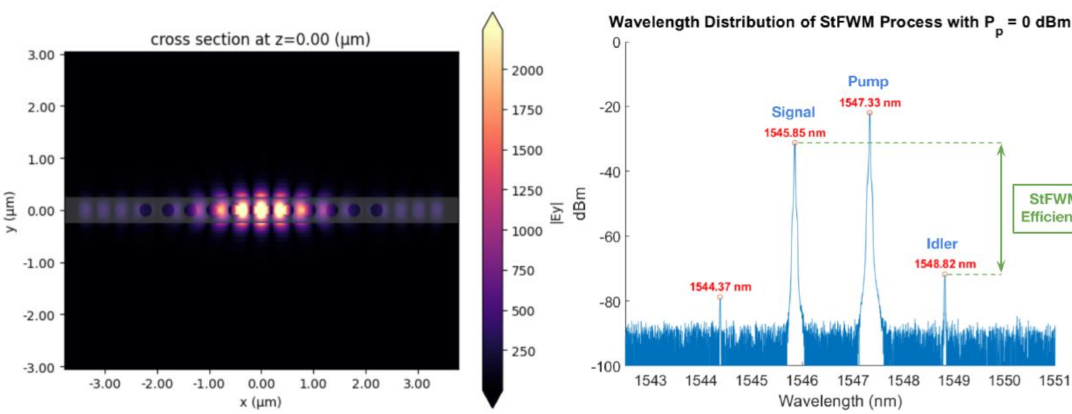
Microcavities are fundamental elements in the development of advanced photonic technologies. For more than a decade, they have been used as key devices for emerging technologies with a high prospect that has the potential to solve key challenges in the design of optical sensors, as well as in the development of nanophotonic and quantum devices [1, 2]. In this context, our work explores the use of the chalcogenide material GeSbS [3] as a medium for the fabrication of micro cavities, highlighting its potential for scalability and providing an arsenic (As) free glass to produce high-performance waveguides [4]. Considering the inherent advantages of this material for photonic applications and taking into account that it has a nonlinear refractive index comparable to silicon [4], we performed numerical simulations of various ring-resonators and one-dimensional (1D) micro-cavities, composed of periodic structures of equidistributed holes or also called Bragg reflector distribution [5] (Fig. 1.a). The objective of this paper is to evaluate and compare the optical performance of chalcogenide micro-cavities with respect their silicon-based counterparts, considering different geometries and to identify those structures with the best figures-of-merit, i.e. low nonlinear losses, high quality factors, resource efficiency in manufacturing, stimulated four-wave mixing (StFWM) (Fig. 1.b), in order to establish optimal design criteria for future experimental implementations on frequency comb generation and entangled pair generation via spontaneous parametric down conversion (SPDC).



(a) **(b)**

Figure 1. a) Simulation of a silicon-based Bragg micro-cavity with circular geometry perforations, showing the electric field profile and evidence of a strongly confined optical mode (image on the left). b) Spectral response of the StFWM process within a silicon ring resonator generating an idler signal, this graphic was taken from [6] (image of the right).

References

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