

Linear and nonlinear characterization of a broadband integrated Si-rich silicon nitride racetrack ring resonator for on-chip applications

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We demonstrate the linear and nonlinear characterization of a plasma-enhanced chemical vapor deposited silicon-rich silicon nitride (SRSN) racetrack ring resonator for on-chip applications within the telecommunication wavelength range. The SRSN waveguide parameters are optimized by employing the refractive index profile measured by ellipsometry to achieve flat dispersion in the telecom band. Furthermore, we measure the thermo-optic coefficient of the micro-resonator by analyzing the temperature-dependent transmission spectra and assess it to be $3.2825 \times 10^{-5} \text{ } ^\circ\text{C}^{-1}$. Additionally, we study power-dependent transmission spectra to investigate the effect of local heating and nonlinear absorption. The power-dependent transmission spectra exhibit a blueshifting of the resonance peak in the visible and near-IR regions, which indicates the presence of nonlinear losses in that range. The power-dependent transmission spectra almost remain unchanged in the telecom band, revealing the absence of nonlinear losses and excellent thermal stability in that wavelength range. Our experimental results reveal that the SRSN-based structure can be employed potentially to realize linear and nonlinear applications in the telecom band. © 2023 Optica Publishing Group

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1. INTRODUCTION

Over the years, silicon (Si)-photonics has emerged as a promising CMOS-compatible material platform for fabricating low-cost, scalable integrated components for on-chip applications [1,2]. Owing to the high-index contrast, high Kerr coefficient, transparency over a broad wavelength range (telecom to mid-IR), and enhanced device performance, Si-on-insulator (SOI) technologies in Si-photonics has been widely accepted for the future generation of CMOS integrated circuits (ICs). Researchers have harnessed Si-photonics and employed in a plethora of applications, including high-speed data processing, sensing [3,4], nonlinear and quantum photonics [5,6], wavelength-division multiplexing (WDM) systems [7,8], and all-optical signal processing [9]. However, despite the tremendous achievement of Si photonics, the small electronic bandgap of Si (1.12 eV) [6] imposes a fundamental limitation owing to the large two-photon (TPA) and free-carrier absorption (FCA) losses below 2.2 μm wavelength [10]. These nonlinear losses are detrimental to the optical performance even at low power and prevent widespread adoption of the Si platform in the telecommunication band [11–13]. On the other hand, Si exhibits a high

thermo-optic coefficient (TOC) ($dn/dT = 1.86 \times 10^{-4} \text{ K}^{-1}$), which makes SOI devices strongly sensitive to the device temperature [14]. The optical properties of Si-based devices are highly influenced by the local heating that arises due to the launch of high-power sources and changes in the environmental temperature. Therefore, Si-based photonic devices face limitations in applications corresponding to high-temperature variation. Different approaches have been reported to reduce the thermal effect of Si-based devices, such as the incorporation of an external metal heater for thermal stabilization [15], cladding layer deposition with a material of negative TOC to compensate for the positive TOC of Si [16,17], and athermal design [18]. The limitation of the Si platform leads to exploring a new flexible CMOS-compatible platform carrying a refractive index lying between Si and SiO_2 , which can be realized for a multitude of photonics applications. In the quest for a proper substitution of the Si platform, researchers are harnessing different material platforms to overcome the limitations associated with Si.

Over the years, stoichiometric Si nitride (Si_3N_4) material has gained significant attention as a promising CMOS platform for building photonic ICs (PICs) [19]. Apart from its

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web both have different abilities to negotiate obstacles encountered when exploring the island s caves forests and shipwrecks this hand drawn island is full of secrets and the story is told through symbols that can be enjoyed by anyone you ll water the garden repair the lighthouse and investigate the mysterious spores key features

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web directed by brad peyton directed by writing credits cast in credits order complete awaiting verification produced by music by andrew lockington music by cinematography by david tattersall director of photography editing by david rennie edited by production design by bill boes art direction by bruce robert hill

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web the mysterious island is a 1929 american science fiction film directed by lucien hubbard based on jules verne s 1874

novel l Île mystérieuse the mysterious island it was photographed largely in two color technicolor and released by metro goldwyn mayer as a part talkie feature with some scenes with audible dialog and some that

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web the mysterious island is an exciting tale of mystery and adventure as a group of castaways struggle to overcome the elements and survive on an uncharted island the novel was written by jules verne in 1874 this is an unusual book for verne because it s more mystery than science fiction

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