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根据《国家自然科学基金条例》、相关项目管理办法规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定资助您申请的项目。项目批准号：12304432，项目名称：基于铌酸锂薄膜畴壁忆阻特性的神经拟态光读取机制研究，资助经费：30.00万元，项目起止年月：2024年01月至 2026年 12月，有关项目的评审意见及修改意见附后。

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附件：项目评审意见及修改意见表

国家自然科学基金委员会

2023年8月24日

引 证 检 索 报 告

一、委托信息

1. 被检作者：钮云飞
2. 被检单位/作者单位：浙江水利水电学院
3. 检索目的：其他
4. 论文发表年：2020-2024
5. 提供论文篇数： 5 篇

二、检索范围

- Science Citation Index Expanded (SCI-EXPANDED) 1900-至今
- JCR 2020-2023；中国科学院期刊分区表 2020-2023 升级版

三、检索结果

●该作者提供的 5 篇代表作中有 4 篇被 SCI 收录，另有 1 篇发表在 SCI 期刊“NANOPHOTONICS”上（详见附件一）；5 篇 SCI 收录论文所在期刊分区如下表：

序号	刊名全称	发表年	所属大类	中科院分区	Top 期刊	JCR 分区	影响因子
1.	JOURNAL OF PHYSICS D-APPLIED PHYSICS	2024	物理与天体物理	3	否	Q2	3.1
2.	PHYSICAL REVIEW APPLIED	2021	物理与天体物理	2	否	Q1	4.931
3.	CHINESE OPTICS LETTERS	2020	物理与天体物理	3	否	Q2	2.448
4.	APPLIED PHYSICS LETTERS	2020	物理与天体物理	2	是	Q2	3.791
5.	NANOPHOTONICS	2023	物理与天体物理	2	否	Q1	6.5

检索报告人：　李乃畅　　　　报告单位：　中国科学院文献情报中心

完成时间：　2024 年 11 月 29 日

中国科学院文献情报中心 引证检索专用章

附件：

一、SCI收录情况

Record 1 of 4

Title: Mitigating waveguide loss in Ge-Sb-Se chalcogenide glass photonics

Author(s): Han, FB (Han, Fengbo); Niu, YF (Niu, Yunfei); Zhang, Y (Zhang, Yan); Gong, J (Gong, Jue); Yu, SL (Yu, Shaoliang); Du, QY (Du, Qingyang)

Source: JOURNAL OF PHYSICS D-APPLIED PHYSICS **Volume:** 57 **Issue:** 30 **Article Number:** 305107 **DOI:** 10.1088/1361-6463/ad43f5 **Published Date:** 2024 AUG 2

Times Cited in Web of Science Core Collection: 2

Total Times Cited: 2

Accession Number: WOS:001215809200001

Document Type: Article

Addresses: [Han, Fengbo; Niu, Yunfei; Zhang, Yan; Gong, Jue; Yu, Shaoliang; Du, Qingyang] Zhejiang Lab, Hangzhou 311121, Zhejiang, Peoples R China.
[Han, Fengbo] Xiamen Univ, Sch Elect Sci & Engn, Fujian Key Lab Ultrafast Laser Technol & Applicat, Xiamen 361005, Fujian, Peoples R China.

Corresponding Address: Du, QY (corresponding author), Zhejiang Lab, Hangzhou 311121, Zhejiang, Peoples R China.

E-mail Addresses: qydu@zhejianglab.edu.cn

ISSN: 0022-3727

eISSN: 1361-6463

Output Date: 2024-11-29

Record 2 of 4

Title: Ultrabright Multiplexed Energy-Time-Entangled Photon Generation from Lithium Niobate on Insulator Chip

Author(s): Xue, GT (Xue, Guang-Tai); Niu, YF (Niu, Yun-Fei); Liu, XY (Liu, Xiaoyue); Duan, JC (Duan, Jia-Chen); Chen, WJ (Chen, Wenjun); Pan, Y (Pan, Ying); Jia, KP (Jia, Kunpeng); Wang, XH (Wang, Xiaohan); Liu, HY (Liu, Hua-Ying); Zhang, Y (Zhang, Yong); Xu, P (Xu, Ping); Zhao, G (Zhao, Gang); Cai, XL (Cai, Xinlun); Gong, YX (Gong, Yan-Xiao); Hu, XP (Hu, Xiaopeng); Xie, ZD (Xie, Zhenda); Zhu, SI (Zhu, Shining)

Source: PHYSICAL REVIEW APPLIED **Volume:** 15 **Issue:** 6 **Article Number:** 064059 **DOI:** 10.1103/PhysRevApplied.15.064059 **Published Date:** 2021 JUN 24

Times Cited in Web of Science Core Collection: 55

Total Times Cited: 63

Accession Number: WOS:000672621900002

Document Type: Article

Addresses: [Xue, Guang-Tai; Niu, Yun-Fei; Duan, Jia-Chen; Jia, Kunpeng; Wang, Xiaohan; Liu, Hua-Ying; Zhang, Yong; Xu, Ping; Zhao, Gang; Gong, Yan-Xiao; Hu, Xiaopeng; Xie, Zhenda; Zhu, Shining] Nanjing Univ, Sch Elect Sci & Engn, Sch Phys, Natl Lab Solid State Microstruct,Coll Engn & Appl, Nanjing 210093, Peoples R China.
[Xue, Guang-Tai; Niu, Yun-Fei; Duan, Jia-Chen; Jia, Kunpeng; Wang, Xiaohan; Liu, Hua-Ying; Zhang, Yong; Xu, Ping; Zhao, Gang; Gong, Yan-Xiao; Hu, Xiaopeng; Xie, Zhenda; Zhu, Shining] Nanjing Univ, Collaborat Innovat Ctr Adv Microstruct, Nanjing 210093, Peoples R China.
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ISSN: 2331-7019

Output Date: 2024-11-29

Record 3 of 4

Title: Efficient 671 nm red light generation in annealed proton-exchanged periodically poled LiNbO₃ waveguides

Author(s): Niu, YF (Niu, Yunfei); Yang, L (Yang, Lei); Guo, DJ (Guo, Dongjie); Chen, Y (Chen, Yan); Li, XY (Li, Xiaoyang); Zhao, G (Zhao, Gang); Hu, XP (Hu, Xiaopeng)

Source: CHINESE OPTICS LETTERS **Volume:** 18 **Issue:** 11 **Article Number:** 111902 **DOI:** 10.3788/COL202018.111902 **Published Date:** 2020 NOV 10

Times Cited in Web of Science Core Collection: 18

Total Times Cited: 22

Accession Number: WOS:000591933400015

Document Type: Article

Addresses: [Zhao, Gang; Hu, Xiaopeng] Nanjing Univ, Natl Lab Solid State Microstruct, Coll Engn & Appl Sci, Nanjing 210093, Peoples R China.
Nanjing Univ, Sch Phys, Nanjing 210093, Peoples R China.

Corresponding Address: Zhao, G; Hu, XP (corresponding author), Nanjing Univ, Natl Lab Solid State Microstruct, Coll Engn & Appl Sci, Nanjing 210093, Peoples R China.

E-mail Addresses: zhaogang@nju.edu.cn; xphu@nju.edu.cn

ISSN: 1671-7694

Output Date: 2024-11-29

Record 4 of 4

Title: Optimizing the efficiency of a periodically poled LNOI waveguide using <i>in situ</i> monitoring of the ferroelectric domains

Author(s): Niu, YF (Niu, Yunfei); Lin, C (Lin, Chen); Liu, XY (Liu, Xiaoyue); Chen, Y (Chen, Yan); Hu, XP (Hu, Xiaopeng); Zhang, Y (Zhang, Yong); Cai, XL (Cai, Xinlun); Gong, YX (Gong, Yan-Xiao); Xie, ZD (Xie, Zhenda); Zhu, SN (Zhu, Shining)

Source: APPLIED PHYSICS LETTERS **Volume:** 116 **Issue:** 10 **Article Number:** 101104 **DOI:** 10.1063/1.5142750 **Published Date:** 2020 MAR 9

Times Cited in Web of Science Core Collection: 82

Total Times Cited: 90

Accession Number: WOS:000519952900001

Document Type: Article

Addresses: [Niu, Yunfei; Lin, Chen; Chen, Yan; Hu, Xiaopeng; Zhang, Yong; Gong, Yan-Xiao; Xie, Zhenda; Zhu, Shining] Nanjing Univ, Coll Engn & Appl Sci, Coll Elect Sci & Engn, Natl Lab Solid State Microstruct, Nanjing 210093, Peoples R China.
[Niu, Yunfei; Lin, Chen; Chen, Yan; Hu, Xiaopeng; Zhang, Yong; Gong, Yan-Xiao; Xie, Zhenda; Zhu, Shining] Nanjing Univ, Sch Phys, Nanjing 210093, Peoples R China.
[Liu, Xiaoyue; Cai, Xinlun] Sun Yat Sen Univ, State Key Lab Optoelect Mat & Technol, Guangzhou 510275, Peoples R China.
[Liu, Xiaoyue; Cai, Xinlun] Sun Yat Sen Univ, Sch Elect & Informat Technol, Guangzhou 510275, Peoples R China.

Corresponding Address: Hu, XP; Xie, ZD (corresponding author), Nanjing Univ, Coll Engn & Appl Sci, Coll Elect Sci & Engn, Natl Lab Solid State Microstruct, Nanjing 210093, Peoples R China.
Hu, XP; Xie, ZD (corresponding author), Nanjing Univ, Sch Phys, Nanjing 210093, Peoples R China.
Cai, XL (corresponding author), Sun Yat Sen Univ, State Key Lab Optoelect Mat & Technol, Guangzhou 510275, Peoples R China.
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未查到 SCI 收录论文:

5.Niu Y, Niu X, Hu X, et al. On-chip wavefront shaping in spacing-varied waveguide arrays[J]. Nanophotonics, 2023, 12(19): 3737-3745. https://doi.org/10.1515/nanoph-2023-0323

Nanophotonics

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期刊名字	Nanophotonics NANOPHOTONICS-BERLIN （此期刊被最新的JCR期刊SCIE收录）	LetPub评分 8.7 75人评分 我要评分 声誉 9.4 影响力 7.9 速度 9.1
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实时影响因子	截止2024年10月29日：5.071	
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Mitigating waveguide loss in Ge–Sb–Se chalcogenide glass photonics

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Abstract

Minimizing propagation loss within waveguides remains a central objective across diverse photonic platforms, impacting both linear lightwave transmission and nonlinear wavelength conversion efficiencies. Here, we present a method to mitigate waveguide loss in $Ge_{28}Sb_{12}Se_{60}$ chalcogenide glass, a material known for its high nonlinearity, broad mid-infrared transparency, and significant potential for mid-IR photonics applications. By applying a sacrifical oxide layer to eliminate etching residues and a subsequent waveguide thermal reflow to smooth lithography-induced line edge roughness, we successfully reduced the waveguide loss down to 0.8 dB cm^{-1} at 1550 nm wavelength. This represents the best result in small-core and high-index-contrast $Ge_{28}Sb_{12}Se_{60}$ channel waveguides. Our approach paves the way for low-loss, on-chip chalcogenide photonic devices.

Keywords: waveguide loss, chalcogenide glass, CMOS compatible process, thermal reflow

1. Introduction

Reducing propagation loss within planar waveguides has emerged as a persistent and critical focus. Low-loss waveguides contribute significantly to improved signal-to-noise ratios, higher detection sensitivities, and enhanced efficiency in light-matter interactions, which serves as the cornerstone for achieving optimal performance in diverse on-chip active and passive devices. To date, extensive research has explored technologies to mitigate the waveguide loss in various photonic flatforms, including silicon [1], silicon nitride [2], silicon carbide [3], germanium [4], and III–Vs [5]. Specifically, low-loss silicon nitride waveguides have reached a remarkably low 0.014 dB cm^{-1} value, which represents the lowest record among all planar waveguide platforms [6]. The successful demonstration of ultra-low loss in silicon nitride waveguides soon promotes several striking technologies, such as self-injection-locked turnkey soliton combs [7], highly coherent supercontinuums for tomography [8], and monolithic on-chip amplifiers [9].

While these material platforms have exhibited successful demonstrations in the near-IR, they become inevitably lossy when entering the mid-infrared (mid-IR) spectral regime due to phonon absorptions. The mid-IR regime holds immense potential for applications in chemical sensing, health monitoring, and spectroscopy due to the presence of numerous 'fingerprint' vibrational bands of molecules in this range [10]. On-chip solutions, facilitated by the emergence of CMOS-compatible technologies, address the growing demand for miniaturization and adherence to SWaP-C (size, weight, power, and cost) criteria for successful commercialization. However, in these devices, waveguide losses exert an inversely proportional impact on key performance metrics. Lower losses directly translate to enhanced sensitivity, reduced noise levels [11], lower thresholds for nonlinearities [12] and signal gain generation [13]. The huge impact of waveguide losses on such

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Research Article

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On-chip wavefront shaping in spacing-varied waveguide arrays

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Abstract: The ability to manipulate light propagation sets the foundations for optical communication and information processing systems. With the ever-growing data capacity and data rate, photonic integrated circuits have attracted increasing attentions of researchers owing to their large-volume integration capacity and fast operation speed. In this work, we proposed and experimentally demonstrated a new wavefront shaping method using waveguide arrays with hyperbolic secant refractive index profiles. Through theoretically analyzing the diffraction and coherence properties, we found that a single waveguide array can perform both imaging and phase transformation, which are the two primary functions of optical lenses. We further expanded this function and fabricated the corresponding devices on a silicon nitride waveguide platform. Deterministic beam shaping, such as focusing, expansion, collimation, and steering, is successfully realized. This wavefront control method exhibits the potential for on-chip optical routing, ranging, sensing, etc., with high integration density and scalability.

Keywords: integrated photonics; wavefront shaping; waveguide array

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1 Introduction

The utilization of wavefront shaping technology has proven to be a highly efficient approach for manipulating the propagation of light. This technology enables the customization of light amplitude, polarization, and phase [1–9]. Despite its demonstrated efficacy, the use of this technology in waveguide systems has been limited because of the difference in scale between the shaped wavefront and the waveguide dimensions [10]. The integration of this technology into waveguide platforms, which are considered the fundamental building blocks of integrated photonics, could offer new opportunities for precisely shaping optical signals in photonic circuits. To achieve on-chip wavefront shaping, it is necessary to simultaneously manage the diffraction and also modulate the phase [11]. On-chip diffraction manipulation has been comprehensively explored through kinds of waveguide systems, such as dielectric waveguides with a height gradient [12], curved waveguide arrays [13], plasmonic waveguides [14, 15], and photonic crystal waveguides [16]. Meanwhile, a precise phase compensation design is typically accomplished through gradient or graded index (GRIN) structures, such as sub-wavelength GRIN waveguide arrays [17, 18], continuous GRIN lenses [8, 19, 20], and gradient metasurfaces [21–23]. It is worth noting that, all those works only achieved either one function, it still remains challenging to achieve precise management of both the effective index profile and the lateral confinement simultaneously in waveguide systems.

Arrayed waveguides stand out as a promising solution for on-chip wavefront shaping. Waveguide arrays have proven to be highly effective for a range of on-chip applications, including imaging [13, 24, 25], light detection and ranging (LiDAR) [11, 26–28], quantum system simulation [29–34], and multiport information processing [35–38]. In wavefront shaping, compensating for the phase of the wavefront and confining the wavevector laterally (perpendicular to the waveguide direction) in arrayed waveguide systems is a challenging task due to the inherent diffraction nature of light. This work demonstrates the successful implementation of on-chip wavefront shaping through the use of dielectric spacing-varied waveguide arrays. Our

Ultrabright Multiplexed Energy-Time-Entangled Photon Generation from Lithium Niobate on Insulator Chip

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A high-flux entangled-photon source is a key resource for quantum optical study and application. Here, it is realized in a lithium niobate on isolator (LNOI) chip, with 2.79×10^{11} Hz/mW photon-pair rate and 1.53×10^{9} Hz/(nm mW) spectral brightness. These data are boosted by over 2 orders of magnitude compared with existing technologies. A 160-nm-broad bandwidth is engineered for eight-channel multiplexed energy-time entanglement. Harnessed by high-extinction-frequency correlation and Franson interferences up to 99.17% visibility, such energy-time-entanglement multiplexing further enhances the high-flux data rate and warrants broad application in quantum-information processing on a chip.

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I. INTRODUCTION

The lithium niobate ($LiNbO_3$, LN) crystal is known for its superior optical performance [1], such as low optical transmission losses and large electro-optical and second-order nonlinear coefficients. Therefore, it is used for the fabrication of top-notch optical devices for both classical and quantum-information applications. Recent progress in thin-film LN-on-insulator (LNOI) [2] technology enables a revolutionary footprint reduction of LN devices by over 3 orders of magnitude, and thus, makes a magnificent step forward towards efficient on-chip photonic integration. Various high-performance on-chip optical devices have been developed based on such LNOI chips, including low-loss waveguides [3–5], high-quality-factor microring resonators [3,5,6], and high-speed electro-optic modulators [7,8], for applications in second-harmonic generation [9–11], optical-frequency comb generation [12,13], and supercontinuum generation [14,15].

Actually, conventional waveguide devices on bulk-crystal LN wafers, with much weaker mode confinement compared with LNOI devices, already show high efficiencies and performances in the form of integrated quantum optical circuits [2,16]. Quantum states can be generated with unparalleled brightness by spontaneous parametric down conversion (SPDC), and further tailored and modulated by domain engineering [17–19] and electro-optic modulation [20–22]. Recently, important progress has been reported, which is that electro-optic modulators have been realized with over 100-GHz [7,8] bandwidth on the LNOI chip. It is not only a breakthrough in classical optical communication, but also offers the ultimate single-photon switching power that can be matched with on-chip photon flux in the order of about 100 GHz. From the nonlinear optical point of view, it is natural to expect, with emerging LNOI technologies, to push the photon-state generation and processing efficiency to that level, fulfilling the requirements of next-generation quantum optical integration. A high-brightness entangled-photon source is one of these key requirements, because it is basis for high-data-rate qubit generation, communication, and processing.

Here, we demonstrate multiplexed energy-time-entangled photon generation from a domain-engineered LNOI chip, with an ultrahigh photon-pair generation rate of 2.79×10^{11} Hz/mW that is compatible with current LNOI electro-optic modulators. Small group-velocity dispersion (GVD) is engineered in the type-zero quasi-phase-matching (QPM) [23] SPDC process in a

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Efficient 671 nm red light generation in annealed proton-exchanged periodically poled $LiNbO_3$ waveguides

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We report efficient generation of 671 nm red light based on quasi-phase-matched second harmonic generation of 1342 nm in $LiNbO_3$ waveguides. The design method and fabrication process of the high-quality annealed proton-exchanged periodically poled channel waveguides were presented. A continuous-wave 1.71 mW red light was obtained with a single-pass conversion efficiency of $47\% \cdot W^{-1} \cdot cm^{-2}$, which is 88% that of the theoretical value. While for 1 mW quasi-continuous-laser input, the corresponding peak power being 2 W, the conversion efficiency reached up to 60%. Our results indicate that the annealed proton-exchanged periodically poled $LiNbO_3$ waveguide is promising for high-efficiency and low power consumption nonlinear generation of visible light.

Keywords: lithium niobate; second-harmonic generation; optical waveguides; proton exchange.

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Coherent red light sources at around 671 nm have important applications such as full-color laser display[1,2], optical cooling and trapping of lithium atoms[3], and generation of entangled beams in quantum information technology[4]. Frequency doubling of neodymium-doped solid-state lasers is a conventional approach to obtain 671 nm laser light sources, and nonlinear crystals based on the quasi-phase-matching technique are commonly used due to the high-frequency conversion efficiency. Generation of red light at 671 nm based on second-harmonic generation (SHG) using quasi-phase-matched bulk crystals has been demonstrated, such as single-pass SHG using periodically poled stoichiometric $LiTaO_3$[5,6] and extra-cavity frequency doubling with periodically poled $KTiOPO_4$[7]. Nonlinear interactions can be more efficient in waveguides compared with that in bulk crystals, because the light field is confined in a small cross section. In addition, high optical intensity is maintained over a long propagation length without divergence by diffraction, and thus efficient frequency conversions can be achieved in a single-pass configuration, reducing the complexity of the optical setup as compared to extra-cavity frequency conversions. There are several techniques to obtain the waveguide structure in $LiNbO_3$, such as annealed proton exchange (APE)[8], Ti indiffusion[9], and optical grade dicing[10,11]. APE $LiNbO_3$ waveguides show low propagation loss and fine nonlinear performance due to the annealing process. Besides, comparing with optical grade dicing, where the high-precision dicing technique is needed, the fabrication process of APE is relatively simple. High-performance quasi-phase-matched second-order nonlinear interactions have been demonstrated in APE periodically poled $LiNbO_3$ (PPLN) waveguides, such as generation of high-brightness entangled photons[12], enhanced electro-optic spectral tuning device[13], and efficient third-harmonic generation in the communication band[14].

In this work, we designed and fabricated APE PPLN waveguides for 671 nm red light generation and characterized the SHG performances of the nonlinear waveguides. The normalized SHG efficiency was $47\% \cdot W^{-1} \cdot cm^{-2}$ for continuous-wave (CW) input at 1342 nm. In addition, when the quasi-continuous fundamental wave (FW) with a peak power of 2 W was used, the conversion efficiency was 60%.

To design the APE PPLN channel waveguides, the geometric structure and the poling period of the waveguide are the key parameters. Since the proton-exchange process only increases the extraordinary refractive index (n_e), only TM modes are supported in z-cut APE waveguides. The extraordinary refractive index change of the APE $LiNbO_3$ waveguide can be described as $\Delta n_e = \delta(\lambda) \cdot C(y, z)$, where $\delta(\lambda)$ is the wavelength-dependent coefficient, and $C(y, z)$ is the normalized proton concentration[15]. The profile of $C(y, z)$ is determined by the channel width W and the annealing depth D[16], and the annealing depths in the z direction and y direction were assumed to be the same for simplicity. To obtain low propagation loss, the surface proton concentration $C_0 \equiv C(0, 0)$ should be smaller than 0.23[16], and thus a relatively large annealing depth is required to support the guide mode in the near-infrared spectral range. The single-mode condition for the FW at 1342 nm was estimated as follows: $W = 6\,\mu m$, $D = 3\,\mu m$, and $0.12 < C_0 < 0.16$. The simulated refractive index increment of the TM_{00} mode at 1342 nm and 671 nm is shown in Fig. 1(a). The effective refractive index of the TM_{00} mode was numerically calculated using COMSOL

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Optimizing the efficiency of a periodically poled LNOI waveguide using *in situ* monitoring of the ferroelectric domains

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ABSTRACT

Lithium niobate on insulator (LNOI) is a unique platform for integrated photonic applications and especially for high-efficiency nonlinear frequency converters because of the strong optical field confinement. In this work, we fabricated a 6-mm-long periodically poled LNOI ridge waveguide with an optimized duty cycle (50:50) using an active domain structure monitoring method. The performance of the single-pass second-harmonic generation and difference-frequency generation in the nanophotonic waveguide was characterized, and the normalized conversion efficiencies were ~80% of the theoretical values. These high-quality frequency conversion devices can pave the way for the application of LNOI in nonlinear integrated photonics.

The lithium niobate on insulator (LNOI) platform has drawn increasing attention in recent years. LNOI inherits the excellent material properties of lithium niobate ($LiNbO_3$) single crystals, such as a wide low-loss transparency window, a strong electro-optic (EO) coefficient,[1] and high second-order nonlinearity.[2] Moreover, an LNOI platform offers stronger optical confinement compared to conventional weakly confining $LiNbO_3$ waveguides, such as proton exchanged and titanium in-diffused waveguides,[3,4] which leads to improved optical signal processing capabilities and enhanced light-matter interactions. Because of these advantages, photonic devices based on LNOI can be more compact and efficient. LNOI has been employed to construct many photonic devices, including high-performance $LiNbO_3$ integrated EO modulators working at CMOS-compatible voltages,[5,6] ultrahigh-efficiency frequency converters,[7,8] high-Q micro-resonators,[9] and photonic crystal micro-cavities.[10]

$LiNbO_3$ has been widely used for second-order nonlinear frequency conversion in nonlinear optics because of its high second-order nonlinear coefficient. To realize efficient frequency conversion in LNOI waveguides, phase-matching is a key aspect. To date, several schemes have been used to achieve phase-matching in LNOI-based nonlinear optical elements, such as modal phase matching,[11–13] metasurface-assisted phase-matching,[14] and quasi-phase matching (QPM). Among these methods, quasi-phase-matched LNOI waveguides can offer several advantages such as phase-matching arbitrary second-order nonlinear optical processes within the transparency range of the crystal, access to the largest nonlinear coefficient, and phase-matching of interactions between the TE_{00} modes that exhibit the tightest mode confinement. Periodically poled ferroelectric domain structures have been fabricated on LNOI platforms, and they have been implemented to demonstrate quasi-phase-matched second-order nonlinear processes such as second-harmonic generation (SHG),[7,15–17] sum-frequency generation (SFG),[18] difference frequency generation (DFG), and spontaneous parametric downconversion (SPDC).[19] Because of sub-wavelength optical confinement, ultrahigh-efficiency frequency conversion, e.g., 2200%–2600% $W^{-1}\,cm^{-2}$ normalized efficiencies for SHGs in the communication C-band, was reported with such nanophotonic waveguides that were several millimeters long.[7,19] However, the measured efficiencies were only ~60% or lower than the