Supplementary material

First Demonstration of Lithium Niobate Photonic Chip for Dense Wavelength-division Multiplexing Transmitters

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Table S1 summarizes the performances of several DWDM transmitters on different platform. Transmitters on SOI have been widely demonstrated based on the micro-ring modulator (MRM), which provides a compact footprint with a low capacitance. By optimizing the p-n junction, depletion-mode Si MRMs used in the transmitters have realized higher bitrate at 112 Gbps per channel [15]. However, the power consumption for modulators based on the plasma dispersion effect is still at the level of tens or even thousands fJ/bit in general, increasing the difficulty in large-scale transmitters. Heterogeneous III-V/Si metal-oxide-semiconductor capacitor（MOSCAP) MRRs have been developed to reducing the power consumption, while the EO bandwidth decreases [16]. Leveraging the Pockels effect of LN, the present LNOI photonic chip based on FP-cavity modulator outperforms other DWDM transmitters in Table S1 in EO bandwidth (> 67 GHz) and power consumption (5.1 fJ/bit) while being equally compact. In addition, the LNOI photonic chip has natural advantages in the linearity and insertion loss, which are not shown in the table.

Table S1 Comparison of DWDM transmitters on different platforms

ref	Material	Structures	Channel number	Channel Spacing (GHz)	EO BW (GHz)	Date rate per channel (Gbps)	Capacity (Gbps)	V_{pp} (V)	Power consumption [a] (fJ/bit)	Footprint [b] (mm^2)
[13]	Si	MRM	11	200 GHz	-	11	88	1.2	30	1.4×0.8 [c]
[11]	Si	MZM + double-ring filter	3	650 GHz	12.8	25	75	7	-	5.4 ×2.8
[10]	Si	MRM + double-ring filter	4	350 GHz	33.8	50	200	2	1220	1.5×1.0 [c]
[15]	Si	MRM	4	200 GHz	38.7	112	448	-	1860	0.64
[17]	Si	MRM	32	80 GHz	-	18	576	1.8	157	32 × (0.067×0.020)
[18]	Si	MDM[d] + RA-MZI[e] interleavers	16×4	100 GHz	-	16	1024	0.8	-	3 × 0.5 [c]
[19]	InP/Polymer	EAML + AWG	8	400 GHz	35	100	800	1.5	-	19.5×15.3
[16]	III-V/Si	MOSCAP[f] MRM + RA-MZI interleavers	17	65 GHz	15	25	425	4	23	-
this work	LN	FP cavity	4	200 GHz	> 67	100	400	1.8	5.1	0.78×0.58

[a] Only the power consumption of modulating is included.
[b] Only the footprint of modulators and DWDM filters is calculated.
[c] Estimate the footprint of the transmitter based on the microscopic photo in the article.
[d] MDM: Microdisk modulator.
[e] RA-MZI: Ring-assisted Mach-Zehnder interferometer.
[f] MOSCAP: Metal-oxide-semiconductor capacitor.