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Title

Sub-picosecond phase-sensitive optical pulse characterization on a chip

Source

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Abstract

The recent introduction(1-3) of coherent optical communications has created a compelling need for ultrafast phase-sensitive measurement techniques operating at milliwatt peak power levels and in timescales ranging from sub-picoseconds to nanoseconds. Previous reports of ultrafast optical signal measurements(4-7) in integrated platforms(8-10) include time-lens temporal imaging(5) on a silicon chip(8,9) and waveguide-based frequency-resolved optical gating (FROG)(4,6,10). Time-lens imaging is phase-insensitive, and waveguide-based FROG methods require the integration of long tunable delay lines, which is still an unsolved challenge. Here, we report a device capable of characterizing both the amplitude and phase of ultrafast optical pulses with the aid of a synchronized incoherently related clock pulse. It is based on a novel variation of spectral phase interferometry for direct electric-field reconstruction (SPIDER)(4,7) that exploits degenerate four-wave mixing in a CMOS-compatible chip. We measure pulses with a peak power of <100 mW, a frequency bandwidth of >1 THz, and up to 100 ps pulsewidths, yielding a time-bandwidth product of >100.