

# Nanosecond polymer Mach-Zehnder interferometer electro-optic modulator using optimized micro-strip line electrode

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**Abstract** A Mach-Zehnder interferometer (MZI) electro-optic (EO) modulator based on micro-strip line (MSL) electrode and guest-host EO polymer DR1/SU-8 is experimentally demonstrated. For achieving high response speed, electrode structure is especially optimized and fabrication technology is seriously controlled. The final characteristic impedance of electrode is about  $49.4 \Omega$ , and the difference between microwave index (1.5616) and lightwave index (1.6006) is also minimized. At 1,550 nm, the insertion loss and extinction ratio are 12 and 16 dB, respectively, and under switching operation, the rise time and fall time are 16.3 and 16.7 ns, respectively. A long-term monitoring over 2000 hours at room temperature (25 °C) is performed on switching response, and a novel mathematical modeling on response time variation is established using logistic function. The rise time and fall time are observed to change from the initial value of ~16 ns to the stable value of ~28 ns within 300 and 2000 hours, respectively. The device exhibits nanosecond response time by virtue of impedance-matched electrode, small index mismatch and serious control on fabrication process.

**Keywords** Integrated optoelectronics · Electro-optic modulator · Poled polymer · Logistic modeling

## 1 Introduction

Electro-optic (EO) polymer based modulator and switch have shown attractive performance and are widely used in optical networks on chip (ONoC), optical interconnects, and

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