Electro Optic Modulation In a Polymer Ringresonator

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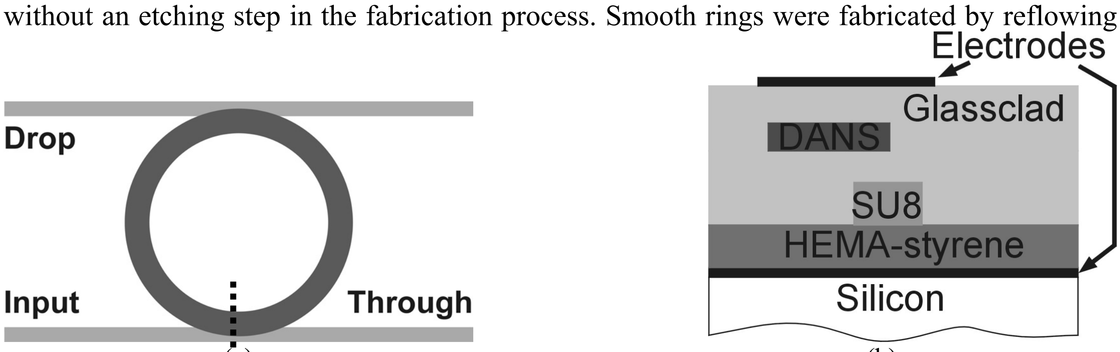
Abstract. A thermo optic and electro optic (EO) tunable polymer ringresonator was realized and tested. The device consisted of a microring resonator made of the 4-dimethylamino-4`-nitrostilbene (DANS) containing polymer and measurements were done on the through port of this device. The ring was used in a vertical coupling structure. The port waveguides were made of the photo-definable epoxy (SU8). The rings used had a diameter of 100 µm and thermo optic tuning of about 170 pm/°C was measured. EO modulation was measured for TE polarization.

REALIZATION

A polymer micro-ringresonator was realized. The device realized is given in figure 1a. A schematic cross section (along the dotted line) of the vertically coupled device is given in figure 1b. By making the waveguide in the photo-definable SU8, a waveguide is created without an etching step in the fabrication process. Smooth rings were fabricated by reflowing



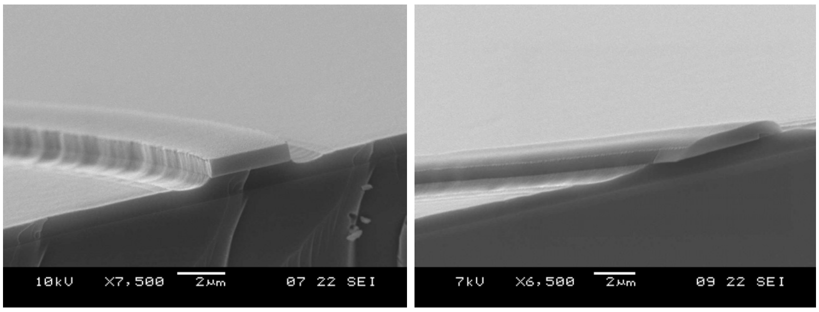
(a) (b)

FIGURE 1 (a) Topview of the realized device. (b) Cross section of the ringresonator.

the DANS containing EO polymer ring after Reactive Ion Etching. When the sample is heated above its glass transition temperature, the ring starts to reflow and surface tension will smoothen the edge of the ringresonator (see figure 2 a and b). The electrodes that apply the electric modulation field over the ring are also used to pole the ring.

CHARACTERIZATION

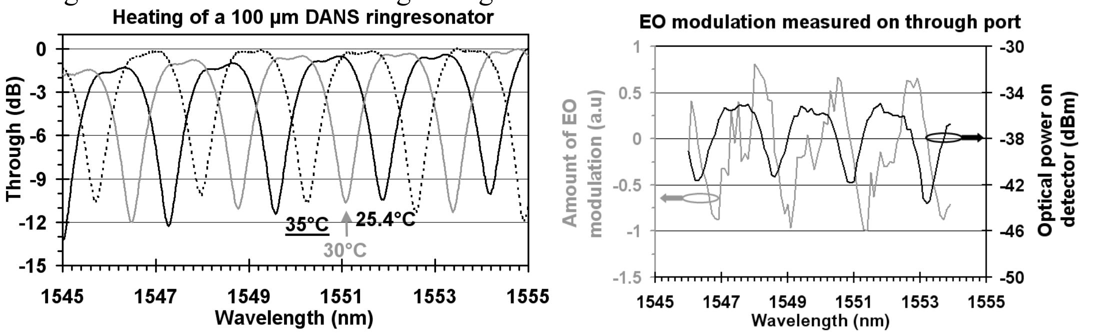
An Erbium Doped Fiber Amplifier (EDFA) spectrum of a single polarization is coupled in with a polarization maintaining fiber at the input of a device with a 100 µm ring. The signal of the through port is measured with a standard telecom fiber connected to a spectrum analyzer. Resonator dips of about 10 dB are observed and tunability of these dips is shown by heating up the resonator. A shift in the resonance dips of about 170 pm/°C is observed (figure 3).



(a) (b)

FIGURE 2 (a) Ringresonator before heating. (b) Ringresonator after heating and reflowing

Electro-Optic (EO) tunability is demonstrated by using a tunable laser instead of the EDFA and apply a 20 Vpp sine modulation voltage (+10 to -10V) over the electrodes. The signal from the through-port is measured with a lock-in amplifier and DC detector. Both results are given in figure 3b. To exclude the possibility of stress induced refractive index changes, the response was analyzed at the modulation frequency and at the double frequency. Because the change in refractive index caused by stress is independent of the field polarity, the effect can only be measured at the double modulation frequency. This measurement yielded close to zero-signal over the entire wavelength range.



(a) (b)

FIGURE 3 (a) Thermo optic tuning of the ringresonator. (b) Measurement (at the modulation frequency) of EO modulation on single ring resonator.

CONCLUSIONS

A polymer microring resonator was realized and characterized. Ringresonators with low scattering sidewalls can be fabricated by reflowing. Thermo optic tunability of 170 pm/°C and EO tunability were shown.

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