3:30pm-4:00pm (Invited)
MI1

High Bandwidth Polymer Modulators

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Nonlinear electrooptic polymer materials have the advantages of fast response and low dispersion. Traveling wave devices made from these polymer materials have an intrinsic higher bandwidth compared with competing material systems. We reported earlier the demonstration of 60 GHz polymer electrooptic modulators, and have now extended this development to 94 GHz devices.

Microwave circuit performance is the limiting factor in extending the frequency response of these devices. The resistive loss of the electrodes becomes higher as the frequency increases. Using optimized device parameters and improved processing techniques, we have designed and fabricated two types of improved electrodes which have low losses at high frequency. Our Coplanar strips configuration requires in-plane poling while our new microstrip line electrode works with our standard corona poling process. We have characterized and tested both electrodes with fin line transitions at 94 GHz to efficiently couple the millimeter wave driving power into the modulators. Figure 1 shows the overview of the polymer modulator, and Figure 2 shows S_{21} of the microstrip line electrode with anti-podal fin line transitions from and to the W-band microwave waveguides.

Effective characterization of the high speed electrooptic phase modulator is also becoming a more difficult issue as the frequency is raised into the millimeter wave range. We have developed a very sensitive heterodyne detection system to characterize the device at high frequency. Figure 3 shows the optical heterodyne detection system with an external-cavity semiconductor tunable laser. In this optical heterodyne detection technique a second YAG laser is used as a local oscillator to down convert the high frequency phase modulated signal to a much lower frequency amplitude modulated signal. Complex and costly high frequency optical signal detection and millimeter wave instrumentation can be avoided in this sensitive detection approach. The external cavity, locked semiconductor tunable laser has a wide wavelength capability, making it possible to characterize the optical phase modulation up to a few THz.

The fabrication procedures for these devices have become more mature and the optical insertion losses have been significantly reduced. Mach-Zehnder optical interferometer waveguides have been fabricated which use the maximum available nonlinearity and directly give an amplitude modulation output. The modulators have been fabricated on silicon wafers for on-chip device driver integration and optical waveguide end surface cleaving techniques have been developed. Further following the concept of integration, MESFET processing compatibility has been examined under the high electric field, high temperature conditions of our polymer poling process and the transistors were not damaged. Thus the polymer modulators are now entering a new phase in which we can project systems that work at extremely high frequencies, in arrays, and with a high level of systems integration with logic and driver elements.

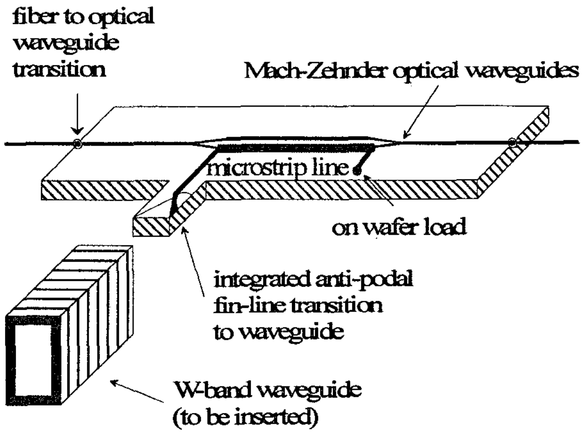

Figure 1. Overview of the polymer modulator.

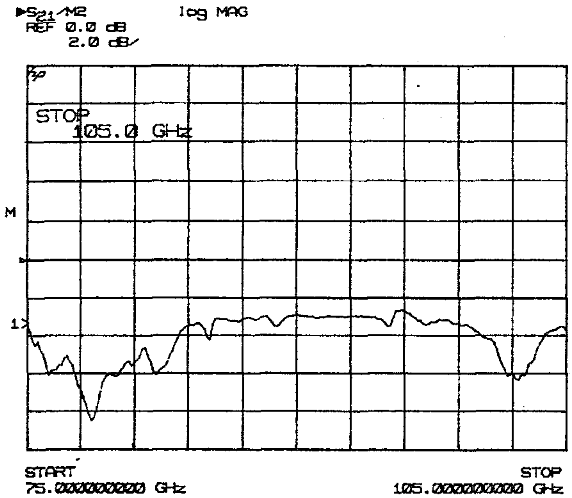

Figure 2 S_{21} of microstrip line with 2 anti-podal transitions to and from W-band waveguide.

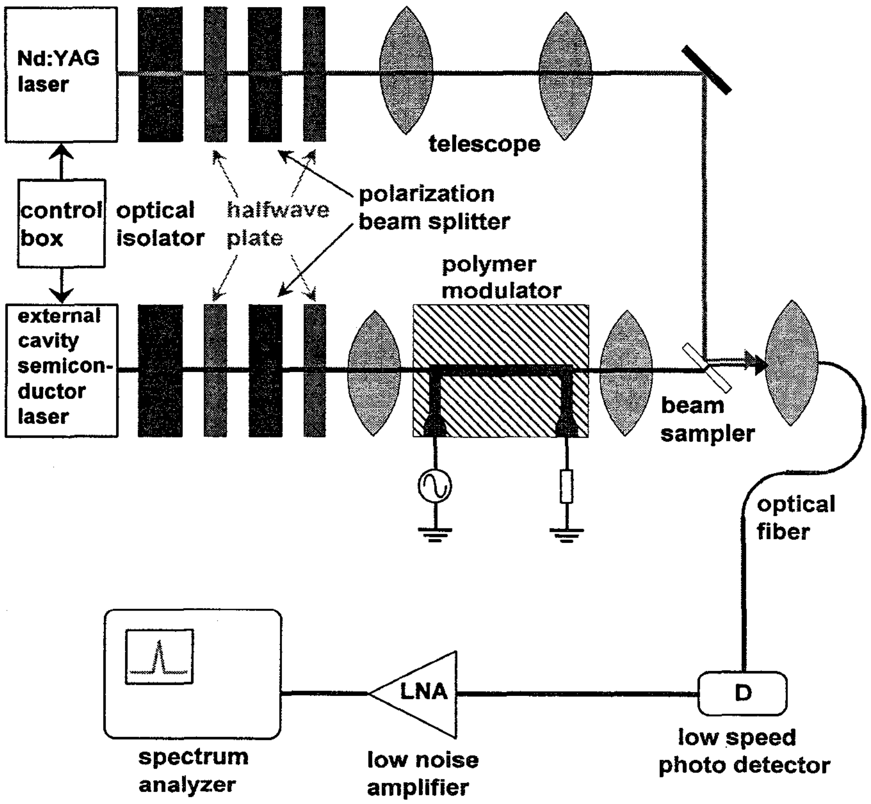

Figure 3 Heterodyne setup with a semiconductor external cavity tunable lasers.