MULTICHIP MODULE HIGH SPEED TESTING

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David H. Auston
Department of Electrical Engineering
Columbia University
New York, NY 10027

Progress:

Research continues on characterization of electro-optic polymers for high speed transmission lines. The poled polymer material we used for this application is a copolymer of methylmethacrylate (MMA) and methacrylate-bound dispersive red #1 dye (MA1). Our previous measurements have shown that this material has several desirable features. First, it has a very large bandwidth. We have measured an electrical transient as short as 760 fs which is only limited by the device parasitic effects. The intrinsic response of the polymer should be much faster. Secondly, it has a relatively large electro-optic coefficient comparable to that of $LiTaO_3$. Thirdly, this material has a small dielectric constant which makes it favorable for integration into the high speed devices.

We have integrated this polymer material into a photoconductive switch-transmission line, and used the electro-optic property of the polymer to characterize the dispersion of the transmission line. This approach has potentially important applications for the characterization of high speed interconnection lines in multi-chip modules.

A femtosecond laser beam is focused down on the biased photoconductive gap to induce an electrical transient which propagates along the transmission line. To measure this transient, we use an electro-optic sampling technique. The polymer is fabricated on the top of the transmission line as electro-optic material. By measuring the shape of the transient at different distances on the transmission line, we can obtain the dispersion properties of the transmission line.

Figure 1 shows the results of our experiments in which the separation x between two pulses is varied. The transmission line has a center conductor width of w = 35 μm, and the slot width of d = 15 μm. Each shows a very sharp rise with the rise time increasing from a minimum 1.1 ps at x = 100 μm, to 1.5 ps at x = 1500 μm. This behavior can be well modeled.

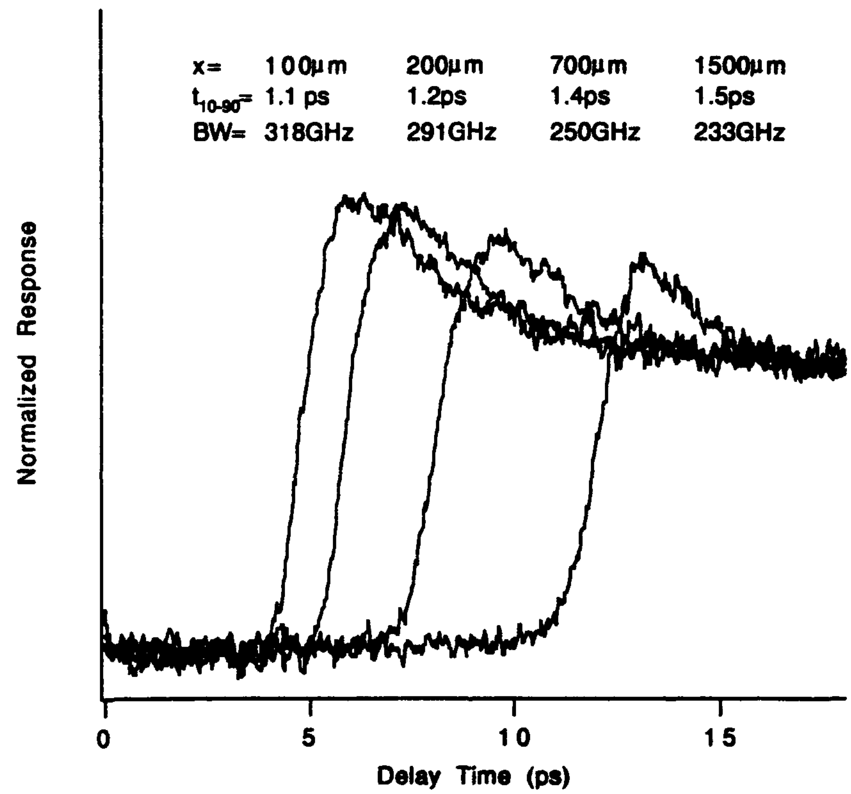

Figure 1. Study of the dispersion property of a transmission line. This data shows the response of the coplanar transmission line with a polymer superstrate, where x is the separation between the pumping and probing spot.

We have also applied the polymer to study the effect due to the size of the transmission line. Figure 2 is the result when the pulse separation is held constant at x = 100 μm, and the dimension is varied. For d = 15 μm, and w = 35 μm, the rise time is 1.1 ps, while for d = 10 μm, and w = 20 μm, the rise time is reduced to 760 fs.

Our experiments have demonstrated the application of the polymer material in characterizing a high speed transmission line. In the future, we are planning to use the polymer material to make a polymer-based Mach-Zehnder interferometer and a traveling wave modulator, both of which could be important components in optical interconnections.

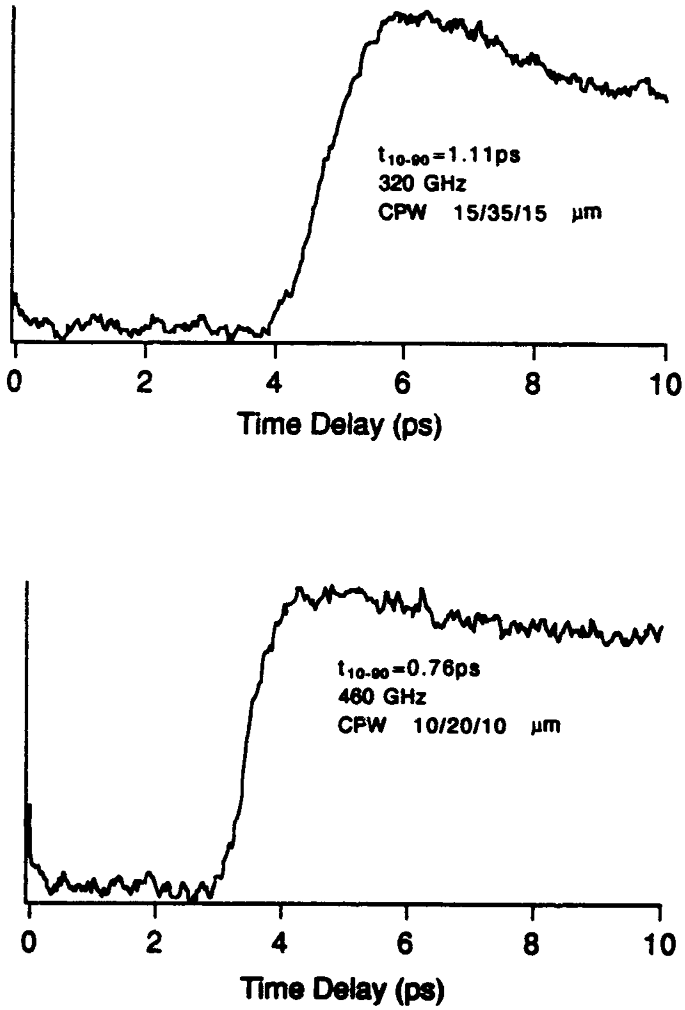

Figure 2. Results on transmission lines with different geometry.

A recent related publication by Paul M. Ferm, Charles W. Knapp, Ajay Nahata, Chengjiu Wu, James T. Yardley, Binbin Hu, Xi-cheng Zhang, and David H. Auston, is "Frequency Response of Electro-optic Polymers," presented at the Second French-Israeli Conference on Nonlinear Optics, and also to be published in the special issue of Nonlinear Optics.