However, the submicron-thick metallic shells, which rapidly decompress on irradiation, implode symmetrically to produce conditions that appear to be similar to those predicted by the 1-D code *LILAC*. Further studies are planned to examine in detail the production of specific levels during shell implosions.

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3.B Two-Dimensional Electric Field Mapping with Subpicosecond Resolution

Very high-speed semiconductor devices, including the hetero-junction bipolar transistor, GaAs MESFET, TEGFET, and MODFET, have a response well within the picosecond regime; for characterization of these ultrafast devices, new instrumentation is needed. Such instrumentation should have good spatial resolution of a few micrometers, a temporal response of a few picoseconds, and minimum interference with the circuit.

We have demonstrated such a technique, which is based on the electro-optic sampler developed earlier at LLE.[1-3] The new method is capable of characterizing the response of microstructures in two dimensions with a temporal resolution of a fraction of a picosecond.

The geometry of the new reflection-mode sampling is shown in Fig. 21.22. A thin slab of $LiTaO_3$ is located near the surface of a coplanar transmission line built on Cr:GaAs substrate. The electrode widths, as well as the distance between electrodes, are 50 μm. The bottom face of the $LiTaO_3$ is covered with a high-reflection coating. An electrical signal is generated by laser-induced photoconductivity in a gap which interrupts one of the electrodes. The gap is 50-μm wide and biased with a few tens of volts. As the signal propagates down the strip line, its fringing field penetrates into the thin slab of $LiTaO_3$ and slightly modifies the crystal birefringence according to the signal strength. This electrically induced change is detected by a probe beam, which is reflected by the dielectric coating. Presently the spatial resolution is 10–15 μm, which can be improved to 0.5 μm by focusing the beam more tightly. Figure 21.23 shows the experimental results when 100-fs optical pulses are used to generate and probe the electrical pulses. The temporal resolution is 0.75 ps in this experiment. The resolution is limited by the double-pass transit time of the probe pulse across the region of induced birefringence; the depth of this region scales down with the electrode spacing. Thus, the transit-time effect can be reduced and the temporal resolution improved simply by reducing the dimensions of the coplanar strip line. In the near future very high-speed Si- or GaAs-integrated circuits will be tested using this technique.

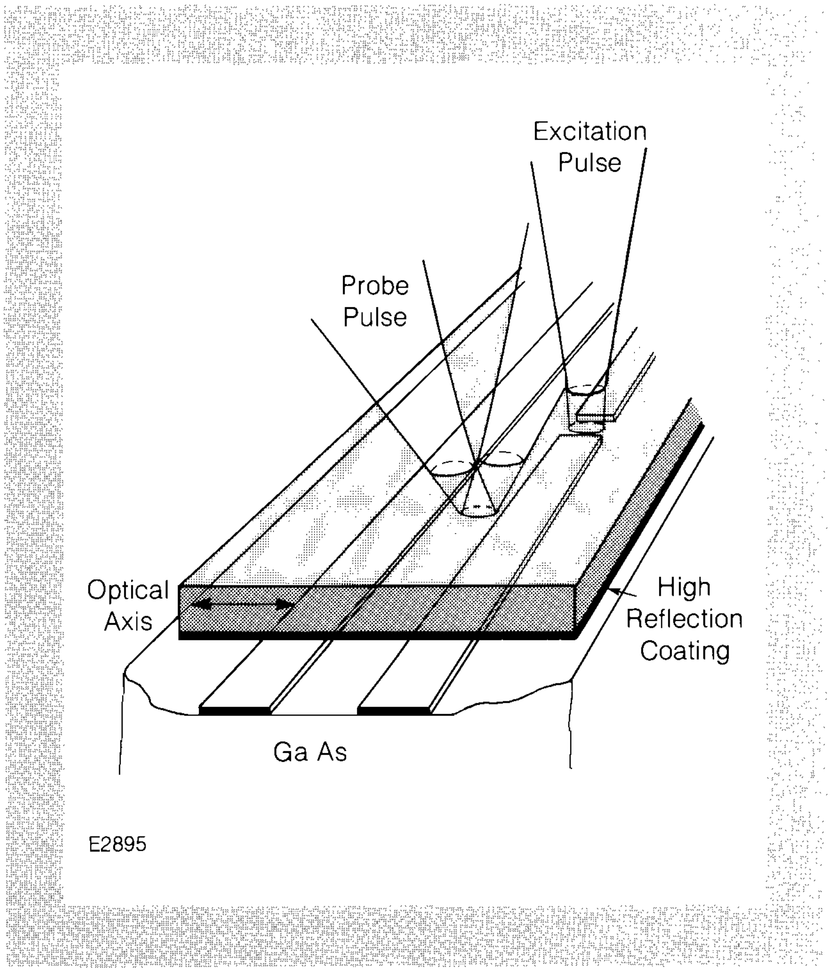

Fig. 21.22
Reflection-mode electro-optic sampler configuration.

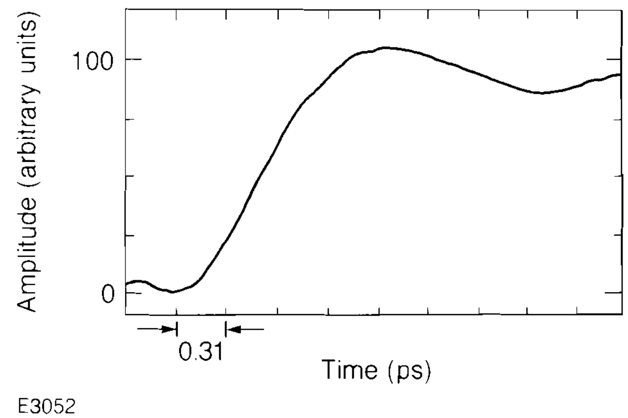

Fig. 21.23
Temporal response of the reflection-mode sampler with coplanar strip-line dimensions of 50 μm. The 10–90% rise time is 0.75 ps.

An alternative sampling technique takes advantage of the electro-optic properties inherent in the GaAs. In this mode, the GaAs device being characterized also serves as the sampling medium; this practically eliminates any interference with the device operation. This technique requires a probe pulse with a wavelength greater than 900 nm in order to avoid band-to-band absorption. Short pulses in the IR regime can be obtained by starting with 620-nm pulses created by a synchronously pumped anti-resonant ring laser.[4] The pulses are amplified with a 1-KHz dye amplifier chain and regenerative amplifier;[5] a white-light continuum in a water cell is then generated. This new sampling configuration is currently under investigation.

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