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Complex reflection coefficient measurements are widely used in materials characterization. The aim of this paper is to develop a technique for complex reflection coefficient measurement using two electrical probes. A biquadratic equation that relates the complex reflection coefficient magnitude to the currents of the semiconductor detectors connected to the probes is derived. In the case where the wrapped phase found from the detector currents lies in the first, second, or fourth quadrant, the complex reflection coefficient magnitude is unambiguously determined from that equation as its smaller positive root. The complex reflection coefficient phase is determined from two quadrature signals, which are easy to find from the semiconductor detector currents once the complex reflection coefficient magnitude is known. To measure the complex reflection coefficient over a frequency range, it is convenient that the interprobe distance be equal to one eighth of the guided operating wavelength at the maximum frequency. It is shown that the complex reflection coefficient and phase determination error caused by the interprobe distance error can be minimized if the specimen is placed in the waveguide section so that the current of the detector connected to the nearer-to-specimen probe is a maximum. In comparison with three-probe measurements, the proposed technique simplifies the design of the measuring waveguide section and the process of its manufacturing and alleviates the parasitic effect of multiple reflections between the probes.

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