Nondestructive Materials Characterization for extracting Electrical Properties using Multi-Reflect Through

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Electrical properties of materials are useful for designing electrical circuits, diagnostic sensors, and quantifying underlying physics. There are many ways to measure electrical properties of materials, this paper will focus on broadband techniques (10kHz to 110GHz). One way to measure electrical properties is to fabricate electrical devices directly onto the material of interest, which is cost-ineffective and destructive. A nondestructive way to measure electrical properties to place the material-of-interest onto an electrical measurement technique uses multiple coplanar waveguide transmission lines that have different lengths, which is called multiline thru-reflect-line (TRL). Combining flip-chip and multiline TRL requires machining the material into a specific geometry, which is destructive. Here, we combined fil-chip with a multi-reflect thru (MrT) technique to achieve the accuracy of multiline TRL without destroying the sample. Instead of multiple transmission lines, our technique uses multiple coplanar waveguide short and open reflects that have different offset lengths, and a 10x10mm square of material. This advancement in electrical property measurements allows the material to be characterized and reuses both the electrical devices and the material. The reuse of the material means confident design of proto-type electrical circuits and sensors.