RF Material Characterization Solutions via Atomic Force Microscopy and Vector Network Analyzers

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Abstract:

We introduce the concepts to combine Vector Network Analysis techniques and Atomic Force Microscopy (AFM) to form a Scanning Microwave Microscope (SMM) which extends the range of impedance measurements to the nanometer scale. The combination presented here connects a standard AFM – (Keysight 5500/5600) to a Microwave Vector Network Analyzer (e.g. via PNA) via a microwave (MW) coaxial cable. The PNA sends a continuous MW signal to the conducting AFM tip and detects the reflected MW signal. The PNA acts as a reflectometer. The amount of reflected signal depends on the load impedance experienced by the AFM tip on in different positions on the investigated surface. To achieve the desired sensitivity, the design of the setup requires appropriate microwave guide designs and impedance matching techniques. When the AFM tip is scanned across the sample surface the reflected signal is mapped simultaneously to the topography. It varies according to the varying tip sample impedance.

On this presentation will address the following topics:

1. Basic concept of Atomic Force Microscopy
2. Scanning Microwave Microscope (SMM) - Connecting PNA and AFM
3. Capacitance and Impedance Measurement
4. Calibration
5. Applications and Extensions