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A New Field Model of the Evanescent Microwave Needle Probe JAMES BAKER-JARVIS, PAVEL KABOS, MICHAEL JANEZIC, MITCH WAL-LIS, NIST — The evanescent microwave probe is useful for determining the permittivity of thin films down to submicrometer scales. Measuring the permittivity on the micrometer scale is becoming more important as devices shrink in size since the representative permittivity must be known at these scales. Currently, models used with the evanescent microwave probe for the determination of the permittivity from resonant frequency and quality factor (Q) data are primarily based on quasistatic approximations. In this paper we develop a full-mode model for the resonant system with attached needle probe suspended above an airgap over a material under test. We develop expressions for the fields in the different regions and then we obtain a resonant condition and solve the nonlinear equation for the resonant frequency given the permittivity of the sample. We compare the model predictions to experiment. This fundamental model allows us to study the nature of evanescent fields used as probes.

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