Correspondence

Comments on "Evanescent Microwaves: A Novel Super-Resolution Noncontact Nondestructive Imaging Technique For Biological Applications"

A. Kumar

Evanescent microwave principles of operation[1] are based on the papers described by Kumar and Smith [1] and Kumar [2]. They described that when a dielectric/semiconductor/biological material is placed in the vicinity of the evanescent waveguide (which is connected to a cavity resonator), the reflection coefficient of the resonator changes. Both the resonance frequency and the quality factor of the cavity resonator are affected by the presence of the material. The amount of change in the resonance depends primarily on the microwave properties of the sample as well as on the distance between the wall (resonator iris to the evanescent waveguide) and the sample, and the effective area of sample in the waveguide. It was also shown that microwave properties of a material are a function of permittivity and permeability.

The authors of the above paper have used the same principle, where a microstrip type resonator and an evanescent probe have been used instead of a waveguide resonator and an evanescent waveguide. Therefore, they should have referenced [1] and [2] in the paper.

I appreciate the authors using evanescent microwaves to map nonuniformities in a variety of materials including metals, semiconductors, insulators, and biological and botanical samples.

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[1] M. Tabib-Azar, J. L. Katz, and S. R. LeClair, *IEEE Trans. Instrum. Meas.*, vol. 48, pp. 1111–1116, Dec. 1999.

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[2] A. Kumar, "Measurement complex permittivity of lossy fluids at 9 GHz," *Rev. Sci. Instrum.*, vol. 47, no. 2, pp. 244–246, 1976.

Author's Reply

M. Tabib-Azar

An extensive list of published work on the subject of evanescent microwave imagin of materials is presented in the above paper[1]. Unfortunately, I was not aware of Kumar and Smith [1] and Kumar [2]. Both [1] and [2] will be properly referenced in future publications on this subject.

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Why Nanovoltmeter Offset Currents do not Explain Measured Deviations in the Quantized Hall Resistance

Dave Inglis and Barry Wood

Chen and Chua [1] have suggested that deviations in the value of resistance in QHR devices with resistive contacts [2], [3] may be attributable to the offset (or bias) current of the nano-voltmeter used to measure the QHR devices. We present two reasons why their explanation is unreasonable.

In Fig. 1(a), we illustrate a QHR device as described by Chen and Chua (CC). Precision measurements are usually made in a bridge configuration but for the purpose of this discussion a rather simpler picture will suffice. The device is at field, the 2-dimensional electron gas is quantized, and a source supplies current I_{SD} ad to the device. The Hall voltage (V_{12}) developed between terminals 1 and 2 in Fig. 1(a) is measured by the nano-voltmeter (V). In the CC model, one of the contacts (2 in our case) has a significant resistance R_c and consequently the bias current of the meter produces a drop in potential, V_d, as it traverses this contact. CC point out that the current I_{SD} is repeatedly reversed during a measurement sequence, and that if the nanovoltmeter bias current is constant during these reversals then V_d will make no contribution to the measured value of V_{12}. This is correct.

Unfortunately they go on to suggest that a mean value of bias current of the order of 3 pA would explain the QHR deviations described in [2]. However, in their analysis they lose track of the fact that it is a *change* in bias current that is required to maintain the effect that they postulate. A mean change of value of bias current of 3 pA implies a *change* in bias current of 6 pA during the measurement time of one current reversal [see CC equation (5)]. In a typical computer-controlled cryogenic current comparator measuring system such as that used in [2], [3], the current reversal time is of the order of one minute. This would necessitate a continuous drift in the bias current of 6 pA per minute, or 360 pA per hour. Furthermore, since a typical QHR measurement involves multiple reversals over a period of about 10 min, this implausibly high drift rate must be maintained for a considerable length of time. CC have measured the bias current drift of two nanovoltmeters

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