Non-linear Transport Imaging by Scanning Impedance Microscopy

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A modified Scanning Impendence Microscopy (SIM) technique is proposed to extend the nanoscale transport measurements of intrinsic material properties to the *non-linear* regime, as exemplified by a detailed study of a model metal-semiconductor interface. The imaging mechanism, surface - tip contrast transfer and optimal experimental conditions of non-linear SIM are discussed in details. This technique can be readily transferred to most existing scanning probe microscopes and its potential for characterization of nonlinear transport phenomena on the nanoscale is discussed.

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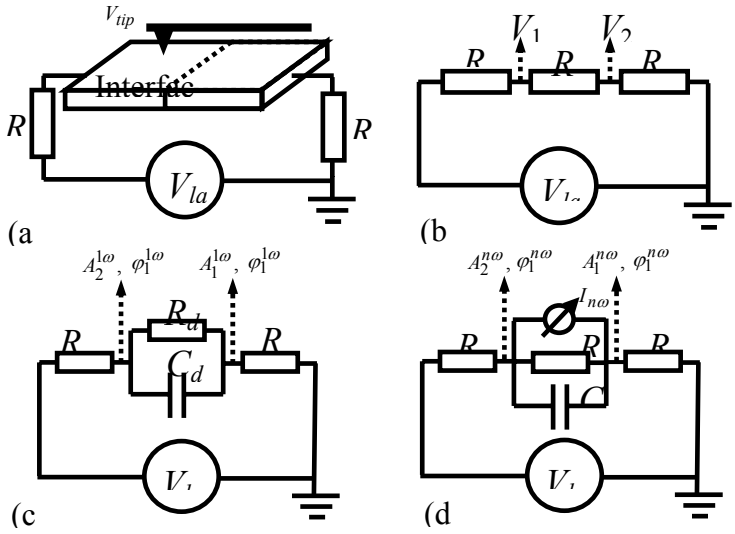

(a) Experimental set-up for dc and ac SPM transport measurements. (b) Equivalent circuit for SSPM based dc transport measurements. The tip measures dc potential distribution induced by lateral dc biased applied across the sample, thus imaging resistive elements of the equivalent circuit. (c) Equivalent circuit for linear SIM measurements. The tip measures distribution of the phase and amplitude of ac voltage, thus imaging the resistive and capacitive elements of equivalent circuit. (d) Equivalent circuit for the non-linear SIM. The tip measures the higher harmonics of potential oscillations in the sample generated due to frequency mixing on nonlinear interfaces, which thus act as current sources at higher harmonics of applied bias.

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