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Analytical quantitative theory of RF-SPM for nanocarbon electronics[1] SLAVA V. ROTKIN, Lehigh University, Department of Physics and Center for Advanced Materials and Nanotechnology — Among a variety of Scanning Probe Microscopy (SPM) tools RF- or microwave-SPM has recommended itself as a versatile characterization tool, recently demonstrated capability to map electronic properties of nanocarbon materials non-destructively and with nanometer resolution. The transparent theory of RF-SPM sensing mechanism is however lacking, mostly limited to numerical or empirical solutions, especially when studying low-dimensional quantum objects, such as nanotubes/nanowires (NT/NW), where the classical description is often invalid. One-dimensional electronic structure of the NT/NW, weak screening of Coulomb interaction and finite e-e compressibility were successfully taken into account to provide an analytic form of its quasi-stationary (due to low RF frequency of the excitation) selfconsistent response. SPM tip response function was, in turn, efficiently analyzed in multipole series, and non-perturbatively diagrammatically summed in the sense of the Random Phase Approximation. Resulting theory shows transparently the physics of RF-SPM sensing mechanism, simultaneously allowing a quantitative analysis of recent RF-SPM data on nanotube electronic devices [E. Seabron, S. MacLaren, X. Xie, SV. Rotkin, JA. Rogers, WL. Wilson, unpublished].

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