Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Scale invariance of a diode-like tunnel junction HUGO CABRERA, DANILO ANDREA ZANIN, LORENZO GIUSEPPE DE PIETRO, THOMAS MICHAELS, PETER THALMANN, URS RAMSPERGER, ALESSANDRO VINDIGNI, DANILO PESCIA, ETHZ — In Near Field-Emission SEM (NFESEM), electrostatic considerations favor a diode-like tunnel junction consisting of an atomic-sized source mounted at the apex of a thin wire placed at nanometric distances from a collector. The quantum mechanical tunnel process, instead, can provide a barrier toward miniaturization. In the first place, it deteriorates the generation of electrons by introducing non-linearities within the classically forbidden zone that exponentially increase with decreasing sizes. In addition, in the direct tunnelling regime, i.e. when the distance between emitter and collector d approaches the subnanometer range, a characteristic length appears, making the cross-over from the (almost) scale-invariant electric-field assisted regime to the essentially different STM-regime. We have observed that the experimental data relating the current I to the two experimental variables V (bias voltage between tip and collector) and d can be made (almost) collapse onto a "scaling curve" relating I to the single variable $V \cdot d^{-\lambda}$, λ being some exponent that depends solely on the geometry of the junction. This scaling property can be used to highlight non-linear aspects of the quantum mechanical tunnelling process.

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Date submitted: 10 Dec 2012 Electronic form version 1.4