Low energy field electron emission from nanostructures: theoretical framework

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Field electron emission (FEE) is a crucial tool of nanotechnology, a source of electron beams valued for its stability, luminescence, and nowadays, safety and low energy consumption. Carbon Nanotubes (CNTs) have been identified as excellent sources for field emission. However, a theoretical framework to describe low-energy field emission is currently unknown, primarily due to the unavoidable, correlated behavior of one-dimensional (1D) materials. This work aims to develop such a theoretical formalism.

It is known that 1D systems are described by the Tomonaga-Luttinger liquid (TLL) theory, which is based on collective modes - plasmon-type modes - automatically accounting for interactions.

Our hypothesis is that TLL can be used here to provide a description of field emission from these systems. In order to prove it, we derived a formalism where the collective effects are included in both the local density of states (LDOS) and in the tunneling amplitude (through a generalization of Fowler-Nordheim theory), as these are the primary factors to be accounted for. As will be shown in the presentation, the theoretical method we have found allows us to study both interaction and temperature effects in field emission.

References

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