The role of electron-electron interactions in electron emission from nanotube materials

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Nanotubes and nanorods have recently been recognized as highly effective materials for serving as electron sources in a process known as field emission (FE). These materials are characterized as one-dimensional (1D), and it is anticipated that interactions between electrons will have a significant impact on their physical behaviour. In our study, we answer precisely this question: how electron-electron interactions influence field emission.

The focus is on the low-energy regime thus it is required to move away from the anti-adiabatic approximation and instead to derive the tunneling amplitude for a finite duration of the tunneling process.

This research identifies the specific conditions under which it is possible to provide an exact analytical expression for the tunneling current.

The formalism is developed that allows us to simultaneously account for both the collective effects arising from electron-electron interactions and thermionic emission.

These results highlight that the various types of nanotubes and their minigap/compressibility parameters can be easily distinguished based on FE measurements on these materials.

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References

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