SUBJECT:

Theoretical and experimental study of the field emission of statistically and two-dimensionally ordered carbon nanotubes

SUPERVISORS:

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In a discipline of materials engineering

DESCRIPTION:

The emission of electron fields is a method of creating an electron beam known for almost a century, which can be later used, for example, in electron- microscopy, spectroscopy or display devices.

Over the years, many years of efforts have been made to improve the spatial accuracy of these devices, and now these systems have reached the nanoscale. This is quite exciting as it has enabled scientists to create new, emerging fields such as vacuum nanoelectronics, and in the near future should give rise to nanoscopic electron beams that can be used for the highest resolution microspectroscopy and micro-diffraction. new pathways to diagnose the structure of heterogeneous materials, as well as local structure modification or catalysis. As a result, low-energy, non-invasive beams with the added value of significantly improved energy efficiency have received widespread attention.

This latest revolution in nanoscopic field emission was made possible largely by the use of a new class of materials - carbon-based nanotubes. In this research project, we intend to look at further improvements to the method, in particular by using nanotube matrices and decorating nanotubes with plasmonic nanoparticles or semiconductor quantum dots. This is a joint theoretical and experimental study in which we will start by developing a theory of field emissions beyond the standard Fowler-Nordheim tunnel model. It will be designed to explain the extremely high emission intensities observed for nanotubes at the lowest voltages. It should also help us find the best combination of nanoparticles to further improve the emission efficiency. At the same time, these theoretical predictions will be verified by means of experiments carried out on devices built on their own, enabling the modification of morphological parameters and the ordering of nanotubes on various substrates.

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