



Erick Costa e Silva Talarico

**Production of Boron doped single walled carbon
nanotubes via different precursors**

Dissertação de Mestrado

Thesis presented to the Programa de Pós-Graduação em Física of the Departamento de Física, PUC-Rio as partial fulfillment of the requirements for the degree of Mestre em Física.

Advisor: Prof. Fernando Lázaro

Co-Advisor: Prof. Marcelo Eduardo Huguenin

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To my Family, girlfriend Jéssica Felix Macêdo and to God,
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Resumo

Talarico, Erick Costa e Silva; Freire Júnior, Fernando Lázaro; Huguenin, Marcelo Eduardo. **Produção de nanotubos de carbono de paredes simples dopados com Boro a partir de diferentes precursores**. Rio de Janeiro, 2012. 125p. Dissertação de Mestrado – Departamento de Física, Pontifícia Universidade Católica do Rio de Janeiro.

Nanotubo de Carbono é um alótropo do Carbono cujo caráter 1D confere-lhe propriedades mecânicas, eletrônicas, térmicas, ópticas excepcionais. Por isso que cientistas têm estudado este material intensamente, tanto do ponto de vista teórico, como de um ponto de vista experimental. Um dos interesses de pesquisa experimental é se conseguir produzir de forma controlada Nanotubos de Carbono com propriedades otimizadas, para aplicações específicas. Outra linha de pesquisa experimental que existe é a de sintetizar Nanotubos de Carbono dopados, com o objetivo de se criar Nanotubos com novas propriedades físicas. A presente dissertação de Mestrado concentra-se na síntese de especificamente Nanotubos de paredes simples dopados com Boro, e tem como objetivos avaliar a viabilidade de se produzir tais Nanotubos dopados com níveis de dopagem controlados, assim como estudar as novas propriedades físicas que surgem em Nanotubos dopados. Inicialmente, neste trabalho será conduzida uma revisão da atual literatura científica sobre Nanotubos de Carbono, com foco nas diferenças físicas entre nanotubos puros e dopados. Em seguida, o aparato experimental e a metodologia utilizada serão descritos. Por fim, os resultados experimentais serão analisados objetivando-se entender a nova física por trás dos nanotubos dopados com Boro, assim como responder à questão se o método adotado conseguiu produzir Nanotubos dopados de forma controlada.

Palavras chave

Nanotubos de Carbono; nanotecnologia; deposição de vapor químico; espectroscopia Raman; espectroscopia de fotoelétrons por raios X; microscopia eletrônica de varredura.

Abstract

Talarico, Erick Costa e Silva; Freire Júnior, Fernando Lázaro (Advisor); Huguenin, Marcelo Eduardo (Co-advisor). **Production of Boron doped single walled carbon nanotubes via different precursors**. Rio de Janeiro, 2012. 125p. MSc. Dissertation – Departamento de Física, Pontifícia Universidade Católica do Rio de Janeiro.

Carbon nanotube is a carbon allotrope whose unique characteristic is its 1D geometry, and that has outstanding mechanical, electronic, thermal, optical properties. Nonetheless, this material has been deeply studied from theoretical and experimental standpoints. From the experimental point of view, there is the interest to create a controlled synthesis of Carbon Nanotubes with optimized physical properties for specific purposes. Another contemporary research interest is on the synthesis of doped Carbon Nanotubes, with the objective of inducing new properties on the Nanotube. This thesis work focuses on the synthesis of, specifically, Boron doped Single Walled Carbon Nanotubes, and aims to study the feasibility of producing Carbon Nanotubes with controlled doping levels by changing the precursor substance, and to understand the new physical properties that arise from the incorporation of Boron heteroatoms on the Carbon Nanotube structure. In this thesis work, a review of the current literature about Carbon Nanotube science is conducted, with focus on the differences in properties between pristine and doped tubes. Then, the experimental setup and methodology is explained. Finally, the experimental results are analyzed in order to understand the new physics of Boron doped Single Walled Carbon Nanotubes, and answer the question of whether a controllable method has been developed to dope Carbon Nanotubes.

Keywords

Carbon Nanotubes; nanotechnology; Chemical Vapor Deposition; Raman Spectroscopy; X-Ray Photoelectron Spectra; Scanning Electron Microscopy

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*Não compreendo os Teus caminhos
Mas te darei a minha canção.*
Ministério Livres para Adorar, *Vai Valer a Pena*