

## 未修饰碳纳米管的细胞毒性机理及其影响因素

1.上海大学 纳米化学与生物研究所, 上海 200444; 2.北京大学 化学与分子工程学院, 北京 100871

## Cytotoxicity of Pristine Carbon Nanotubes: Mechanism and Influencing Factors

1. Institute of Nanochemistry and Nanobiology, Shanghai University, Shanghai 200444, China; 2. College of Chemistry and Molecule Engineering, Peking University, Beijing 100871, China

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## 摘要

随着碳纳米管(carbon nanotubes, CNTs)制备技术的成熟和潜在应用的开发, CNTs的毒性也逐渐引起人们的重视.就未修饰CNTs而言,目前已有大量的文献报道了它们的细胞毒性的效果、机理、影响因素等.一种观点认为, CNTs通过影响细胞粘附、细胞周期或引起细胞内氧化应激水平的提高等手段,导致细胞发生凋亡,存活率下降.但也有些研究发现, CNTs具有较高的生物安全性,没有显著的细胞毒性.存在对立的实验结果的主要原因是影响CNTs细胞毒性的因素很多. CNTs杂质的种类和含量、纯化方法不同,细胞培养环境的不同甚至生物终点检测方法的不同,都会影响对CNTs细胞毒性的判断. CNTs本身的性质,包括长度/直径、分散性等也都影响着CNTs的细胞毒性.为了更准确地评估CNTs的细胞毒性,建立标准样品,统一检测方法势在必行,即建立CNTs标准品和暴露剂量标准,发展适合CNTs的细胞毒性检测方法.归纳总结了以上各方面的研究成果,对今后的相关研究提出看法和建议.

关键词: [碳纳米管](#); [细胞毒性](#); [氧化应激](#)

## Abstract:

With the development of production and application of carbon nanotubes (CNTs), the toxicity of CNTs has attracted much research attention. Cytotoxicity of pristine CNTs and its mechanism and influencing factors have been widely reported. CNTs are reported to induce cell apoptosis/necrosis and reduce cell viability by influencing cell adhesion, cell cycle progress or oxidative stress. On the contrary, some researchers report that CNTs have little effects on cells. The conflicting results come from the fact that many chemical and physical properties affect cytotoxicity of CNTs, including the impurities of CNTs, the purification method, the size of CNTs, aggregation/dispersion of CNTs, cell culture condition, and even analysis methods. It is essential to establish standard reference samples and detection methods for accurate assessment of the CNTs cytotoxicity. This review summarizes the research achievements on the cytotoxicity of pristine CNTs, and gives the perspective of the future research.

Keywords: [carbon nanotubes \(CNTs\)](#); [cellular toxicity](#); [oxidative stress](#)

收稿日期: 2010-06-08;

基金资助:

国家重点基础研究发展计划(973计划)资助项目(2006CB705604)

通讯作者 刘元方(1931~),男,教授,中国科学院院士,博士生导师,研究方向为纳米生物学. Email: [yliu@pku.edu.cn](mailto:yliu@pku.edu.cn)

## 引用本文:

刘元方1, 2刘佳蕙1, 2王海芳1.未修饰碳纳米管的细胞毒性机理及其影响因素[J] 上海大学学报(自然科学版), 2010, V16(5): 447-459

LIU Yuan-fang-1, 2LIU-Jia-hui-1, 2WANG-Hai-fang-1. Cytotoxicity of Pristine Carbon Nanotubes: Mechanism and Influencing Factors[J] J. Shanghai University (Natural Science Edition), 2010, V16(5): 447-459

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