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FILLED CARBON NANOTUBES AS MULTIFUNCTIONAL NANOPLATFORMS FOR CANCER THERAPY AND BIOIMAGING

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ABSTRACT

This work tries to give a vast perspective and a critical analysis of the different ways to explore Carbon nanotubes (CNTs) in oncologic applications. Furthermore, we intent also to give an overview about the concerns about CNTs toxicological effects and possible strategies for reduce the risks related with these issues under different in vitro and in vivo scenarios. Particular relevance will be given to the potentialities of carbon nanocapsules for the development of new strategies for cancer therapy and bioimaging.

Keywords: carbon nanocapsules, multifunctional nanoplatforms, cancer therapy, bioimaging.

INTRODUCTION

CNTs have been wide explored during the years for the development of new applications in many different areas of biomedicine, with particular relevance on the field of oncology. (Serpell, 2016) Great progress has been made using CNTs as a multifunctional nanoplatform for detecting cancerous cells, delivering drugs or other therapeutic biomolecules by taking fully advantage of its specific 1D nanostructure. However, the success of CNTs in biomedical applications have been rather limited by the presence of metallic impurities and lengths in the micron range, that promotes bioaccumulation and increase of the carcinogenic risks. (Kostarelos, 2008).

RESULTS AND CONCLUSIONS

The biointerfacial phenomena of CNTs can be accurate by controlled modulation of their surface functionalities according to the required biological specifications. It has been reported that short and surface functionalized CNTs with can exhibit long circulation time and low uptake by the reticuloendothelial system and high tumor accumulation. (Marchesan, 2015) In this sense, the steam treatment of CNTs, revealed to be a soft an efficient approach for increase biocompatibility though the reduction of metallic impurities and shortening the length for both SWCNTs (Ballesteros, 2008) and MWCNTs (Cabana, 2015). Recently, it was reported that steam treated short MWCNT, decorated with SPION nanoparticles, are able to combine two improved bioimaging modalities (SPECT/CT and MRI) with a high in vitro and in vivo biocompatibility (Wang, 2014)

Beyond the external sidewall functionalization, CNTs offer also the possibility to be filled by materials with high therapeutic or bioimaging relevance on its hollow cavity in order to develop hermetic sealed carbon nanocapsules. (Martincic, 2015) Spinato et al. reported the encapsulation of radioactivable metal halides, $SmCl_3$ and $LuCl_3$, on steam-purified SWCNTs

that were subsequently functionalized with monoclonal antibody (Cetuximab). The authors observed the in vitro efficiency of this functionalized nanocapsules by studying the preferential internalization for cancer cells (U87-EGFR+). (Spinato, 2016) Recently, an unprecedented work demonstrated the ability of these carbon nanocapsules to hermetic seal a gas for bioimaging. Serpell et al. reported the successful encapsulation of Krypton in SWCNTs decorated with peptides for X-ray fluorescence mapping of sub-cellular targets. (Serpell, 2016) These new hybrid carbon nanocapsules have showed promising results for cancer therapy and diagnosis and we estimate great potential to be explored in the combination with many other materials and the new synergistic properties achieved.

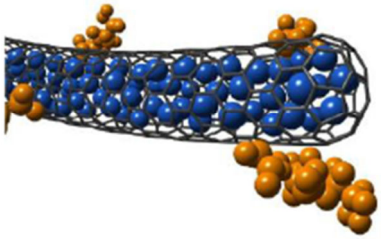

Fig. 1 - Schematic representation of a carbon nanocapsule (grey) filled with active material (blue) and functionalised with suitable biomolecules for targeting purposes (orange) as a novel nanoplatform for cancer therapy.

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