Raman spectroscopy analysis and mapping the biodistribution of inhaled carbon nanotubes in the lungs and blood of miceRaman spectroscopy analysis and mapping the biodistribution of inhaled carbon nanotubes in the lungs and blood of mice

Taylor Ingle, Enkeleda Dervishi, Alexandru R Biris, **Thikra Mustafa**, Roger A Buchanan, Alexandru S Biris

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Abstract

Because of their small size, robust structure and unique characteristics, carbon nanotubes (CNTs) are increasingly being used in a variety of biomedical applications, materials and products. As their use increases, so does the probability of their unintended release and human exposure. Therefore, it is important to establish their potential biodistribution and biopersistence to better understand the potential effects of their exposure to humans. This study examines the distribution of CNTs in CD-1 mice after exposure by inhalation of single-walled carbon nanotubes (SWCNTs) and investigates the possibility that inhaled nanoparticles could enter the circulatory system via the lungs. Raman spectroscopy was employed for the detection of CNTs in lung tissue and blood based on their unique spectroscopic signatures. These studies have important implications concerning the potential effects of exposure to SWCNTs and their use as potential transport vehicles in nanomedicine.

The effect of carbon nanotubes and graphene on the mechanical properties of multi-component polymeric composites

Chemical Physics Letters Volume 590, 18 December 2013, Pages 126–130

Enkeleda Dervishi, Festus Hategekimana, Laurent Boyer, Fumiya Watanabe, Thikra Mustafa, Abhijit Biswas, Alexandru R Biris, Alexandru S Biris

Abstract

Two types of nano-materials (nanotubes and graphene) were incorporated at different concentrations into a bio-compatible polymer matrix, and the mechanical properties of the composite films were studied. Although both nanomaterials improved the mechanical attributes of the polymer, it was found that the composites containing the nanotube–graphene mixture exhibited significantly superior elasto-plastic properties. This work presents a facile technique of fabricating nano-composites that could be scaled up and applied to various types of polymers. These multi-component films have the potential to be used in a wide range of applications including bio-medicine and photovoltaics, as well as the military and automotive industry

Circulating tumor cell identification by functionalized silver-gold nanorods with multicolor, super-enhanced SERS and photothermal resonances

Zeid A Nima, Meena Mahmood, Yang Xu, Thikra Mustafa, Fumiya Watanabe, Dmitry A Nedosekin, Mazen A Juratli, Tariq Fahmi, Ekaterina I Galanzha, John P Nolan, Alexei G Basnakian, Vladimir P Zharov, Alexandru S Biris

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Nanotechnology has been extensively explored for cancer diagnostics. However, the specificity of current methods to identify simultaneously several cancer biomarkers is limited due to color overlapping of bio-conjugated nanoparticles. Here, we present a technique to increase both the molecular and spectral specificity of cancer diagnosis by using tunable silver-gold nanorods with narrow surface-enhanced Raman scattering (SERS) and high photothermal contrast. The silver-gold nanorods were functionalized with four Raman-active molecules and four antibodies specific to breast cancer markers and with leukocyte-specific CD45 marker. More than two orders of magnitude of SERS signal enhancement was observed from these hybrid nanosystems compared to conventional gold nanorods. Using an antibody rainbow cocktail, we demonstrated highly specific detection of single breast cancer cells in unprocessed human blood. By integrating multiplex targeting, multicolor coding, and multimodal detection, our approach has the potential to improve multispectral imaging of individual tumor cells in complex biological environments.

Single-walled carbon nanotube and graphene nanodelivery of gambogic acid increases its cytotoxicity in breast and pancreatic cancer cells

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Lamya M Saeed, Meena Mahmood, Sebastian J Pyrek, Tariq Fahmi, Yang Xu, **Thikra Mustafa**, Zeid A Nima, Stacie M Bratton, Dan Casciano, Enkeleda Dervishi, Anna Radominska-Pandya, Alexandru S Biris

ABSTRACT

Graphene and single-walled carbon nanotubes were used to deliver the natural low-toxicity drug gambogic acid (GA) to breast and pancreatic cancer cells in vitro, and the effectiveness of this complex in suppressing cellular integrity was assessed. Cytotoxicity was assessed by measuring lactate dehydrogenase release, mitochondria dehydrogenase activity, mitochondrial membrane depolarization, DNA fragmentation, intracellular lipid content, and membrane permeability/caspase activity. The nanomaterials showed no toxicity at the concentrations used, and the antiproliferative effects of GA were significantly enhanced by nanodelivery. The results suggest that these complexes inhibit human breast and pancreatic cancer cells grown in vitro. This analysis represents a first step toward assessing their effectiveness in more complex, targeted, nanodelivery systems.

Calcium-channel blocking and nanoparticles-based drug delivery for treatment of drug-resistant human cancers

Therapeutic Delivery Vol. 5, No. 7, Pages 763-780

Meena Mahmood, Thikra Mustafa, Yang Xu, Zeid Nima, Ganesh Kannarpady, Shawn Bourdo, Daniel Casciano, Alexandru S Biris

BACKGROUND :

Cancer cell chemoresistance is one of the major limitations to successful cancer treatment and one of the factors that is responsible for the possible recurrence of the disease. Here, we aimed to combine a calcium-channel blocker, verapamil, with an alternative delivery of the anti-cancer drug, doxorubicin, using nanostructural materials. This approach could reduce the cellular resistance to chemotherapeutics agents.

Nanodelivery of Parthenolide Using Functionalized Nanographene Enhances its Anticancer Activity

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Alexandru S Biris, Alokita Karmakar, XU Yang, Thikra Mustafa, Stacie Bratton, Anna Radominska-Pandya, Peter Crooks

Advances in anticancer chemotherapy have been hindered by the lack of biocompatibility of new prospective drugs. One significant challenge concerns water insolubility, which compromises the bioavailability of the drugs leading to increased dosage and higher systemic toxicity. To overcome these problems, nanodelivery has been established as a promising approach for increasing the efficacy and lowering the required

dosage of chemotherapeutics. The naturally derived compound, parthenolide (PTL), is known for its anti-inflammatory and anticancer activity, but its poor water solubility limits its clinical value. In the present study, we have used carboxyl-functionalized nanographene (fGn) delivery to overcome the extreme hydrophobicity of this drug. A water-soluble PTL analog, dimethylaminoparthenolide (DMAPT), was also examined for comparison with the anticancer efficacy of our PTL-fGn complex. Delivery by fGn was found to increase the anticancer/apoptotic effects of PTL (but not DMAPT) when delivered to the human pancreatic cancer cell line, Panc-1. The IC50 value for PTL decreased from 39 μM to 9.5 μM when delivered as a mixture with fGn. The IC50 of DMAPT did not decrease when delivered as DMAPT-fGn and was significantly higher than that for PTL-fGn. There were significant increases in ROS formation and in mitochondrial membrane disruption in Panc-1 cells after PTL-fGn treatment as compared to PTL treatment, alone. Increases in toxicity were also seen with apoptosis detection assays using flow cytometry, ethidium bromide/acridine orange/DAPI staining, and TUNEL. Thus, fGn delivery was successfully used to overcome the poor water solubility of PTL, providing a strategy for improving the effectiveness of this anticancer agent.