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Carbon Nanotubes for Radiation Therapy

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INTRODUCTION

WHAT ARE NANOTUBES ?

- Nanotubes are allotropes of Carbon in a cylindrical nanostructure (which in a scale of a billionth of a meter).
- At this very small scale, certain elements, like Carbon, exhibit different properties than they do on the normal or macro scale.
- Currently, there are 5 main types of nanotubes, which are as follows :

CARBON NANOTUBES FOR RADIATION THERAPY

NANOTUBES FOR RADIOTHERAPY

- **How it works?**
The single walled nanotube is used as an open capsule containing the required irradiated drug.
- **Why it works?**
Since the irradiated drug behaves as a bunch of photons, they can easily get out at their intended destinations.

DRUG DELIVERY MECHANISM

- A single-walled nanotube 'cage' is used to store and transport the required drug to the target area in the body. [2]
- This capsule is filled with molten radioactive metal halide salts. [2]
- Upon cooling, the ends of the tube seal creating a tiny nanocapsule with a 'sugary' outer surface, to improve its compatibility inside the body. [2]
- This now sealed nanotube is then introduced into the body through this sugary pill.

WHY IS IT BETTER ?

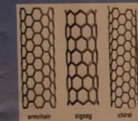
- Though today's traditional radiotherapy is non-invasive, it does end up damaging the surrounding healthy cells.
- In testing done so far (on lab mice), it has shown no problems with radiation leaking into the healthy parts of the body or any other such consequences. [1]

RESEARCH BEING DONE...

- This potential breakthrough is the result of the hard work of the team consisting of:
- Ben Davis, and
 - Malcolm Green
- from the University of Oxford, UK and
- Kostas Kostarelos from the School of Pharmacy, University of London, UK. [1]

1.) SINGLE-WALLED CARBON NANOTUBES

2.) MULTI-WALLED CARBON NANOTUBES (CROSS-SECTIONAL VIEW)



<http://www.hio.org/jmg/2003/186.htm>

Chiral indices (4,4) (7,0) (6,1)

RADIOACTIVE SODIUM IODIDE ENCLOSED IN A SEALED NANOTUBE AND TARGETED TO THE LUNGS USING N-ACETYLGLUCOSAMINE AS TAG (SHOWN HERE IN THEIR HALIDE SALT FORM)

A.) NANOCAPSULE REACTING AT INTENDED TARGET

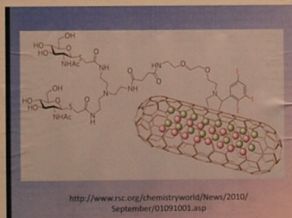
B.) RADIOTHERAPY CONTINUES ONCE DRUG REACHES ITS TARGET

3.) TORUS (SEEN HERE AROUND A SINGLE WALLED CARBON NANOTUBE)

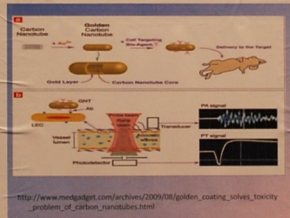
4.) CUP-STACKED



<http://www.primo.co.uk/Balmain/Product.aspx?ProdID=418>



<http://www.rsc.org/chemistryworld/news/2010/September/01091001.asp>

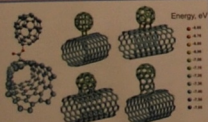


http://www.medpagetoday.com/archives/2009/08/golden_coating_solves_toxicity_problem_of_carbon_nanotubes.html

OTHER USES OF NANOTUBES

- Due to their nature, nanotubes have wide ranging existing and potential applications.
- They are also being used in various maritime components, sports gear and some wind turbines.
- In the medical field, they are used as supports for bone growth and in alternate cancer therapies (such as the Kanzius cancer therapy).

5.) CARBON NANOBUDS (WITH COLOR-CODED ELECTRICAL CONDUCTIVITIES FOR EACH TYPE)



<http://chemistry.about.com/od/nanotechnology/a/Carbon-Structures--Carbon-Nanobuds.htm>

ROLE OF THE NANOTUBE

- This closed form of the tube avoids any punctures to internal organs. [1]
- To ensure that the nanotube reaches its correct destination, its outer surface is modified with either a sugar or other targeting molecule. [1]
- This targeting molecule is derived from the halide salt used before cooling.
- Depending on the target organ or region, different salt compounds of the targeting molecules are used.
- For example, N-acetylglucosamine is used to send it to the lungs. [1]

FINAL ROLE OF THE DRUG

- The radioactive drug acts upon the intended cancerous cells.
- The unradioactive form of drug formed as the by-product normally ends up in the thyroid, liver and bladder. [1]
- There still may be a minuscule chance that this might cause further complications, but they would be treatable and not as grave as the original cancer.

REFERENCES

- [1] - Broadhead, Phillip, "Are nanotubes the future for radiotherapy?" <http://www.rsc.org/chemistryworld/02Feb2011/25Apr2011>
- [2] - Wilkins, Pete, "Nanocapsule delivers radiotherapy" <http://www.physorg.com/16Feb2011/25Apr2011>

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