

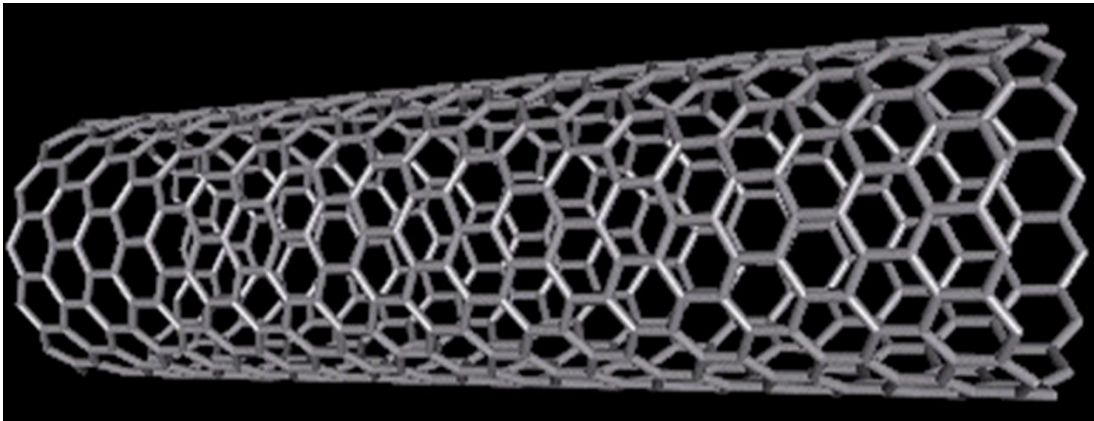
Carbon nanotubes

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1. Introduction

My research focuses on carbon nanotubes(CNT), which attracts many researchers today. Do you have any idea what CNT are?

A Japanese scientist, Toshio Iijima, found CNT in 1991.

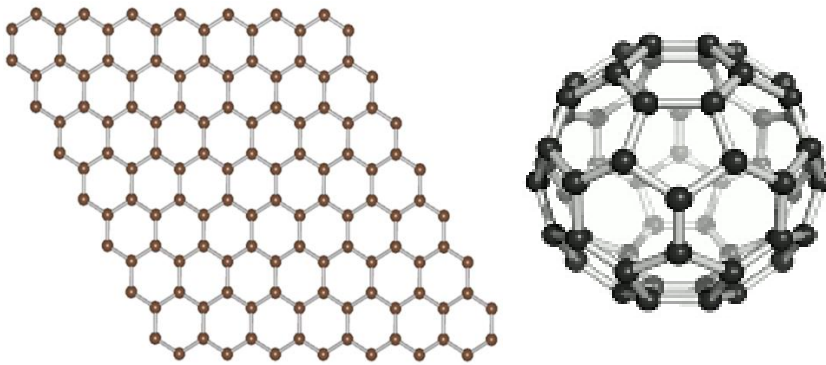


↑general single-walled carbon nanotubes (<http://www.org-chem.org/youki/nanotube/nanotube.html>)

1 nano meter is 1/1,000,000,000 of a meter-long, and general CNT's width varies between 0.4nm (nano meters)~40nm so carbon nanotubes are extremely small. The aspect ratio (proportion of a length to a width) of CNT is high, which makes them strong, light and flexible. For example, if you make a CNT with a width of 1m, its length will be 1000km and Asahi-yama zoo is about 1000km from Tokyo. (Imizu, O(2016), "NEDO report All about Carbon Nanotubes", Nikkan-kogyo publishing)

2. History

A Carbon Nano Tube is composed of carbon, but carbon that is small enough called nano carbon was not widely available until 1980s. Until then, scientists regarded diamond and graphite as the only variations of carbon. However, after three scientists from the UK and the US found fullerene in 1985. After that, research on nano carbon dramatically increased. In 1990, Dr. Kretschmer and Dr. Huffman developed the arc discharge which accelerated the speed of this research (Imizu, O(2016), “NEDO report All about Carbon Nanotubes”, Nikkan-kogyo publishing). I am focusing on CNT that were subsequently developed.



↑ graphene (left) and fullerene

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<http://www.jst.go.jp/pr/announce/20080624/icons/zu1.gif>

3. Features and my research question

My main research questions are; Will carbon nanotubes make a huge innovation in material science? and What is the application of CNT with the possible space elevator? I set these after having learned their outstanding features written below.

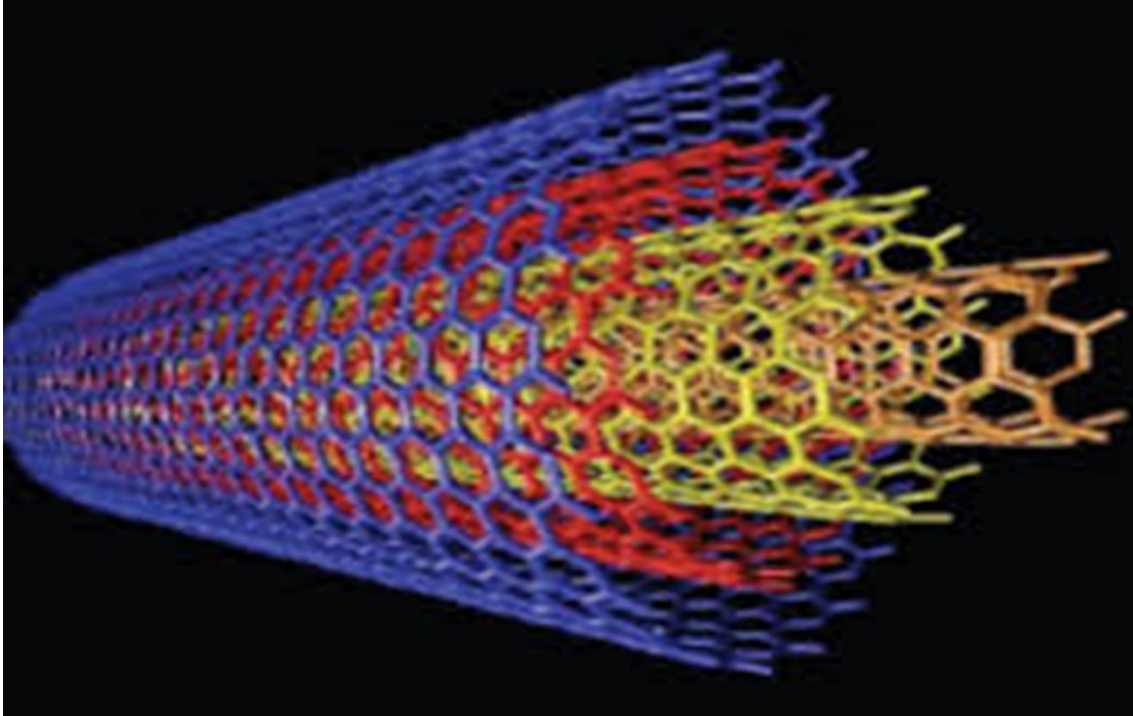
Feature 1 ...CNT can act as either semiconductor or metal

There are two kinds of CNT. One is single walled carbon sheet and the other is multi walled. Single walled CNT changes its type between semiconductor or metal as we make changes into the walling. It is extremely interesting because for most materials it is impossible to change their electrical conductivity only by changing their structure.

Feature 2...Light, strong and flexible

2nd feature makes CNT have much potential. Please imagine, if there was a material which is stronger than steel and lighter than plastic. This would be an

incredible material. CNT can potentially be applied in the field of electronics, medicine, nano-technology, energy and chemistry . That's why I made this research question.

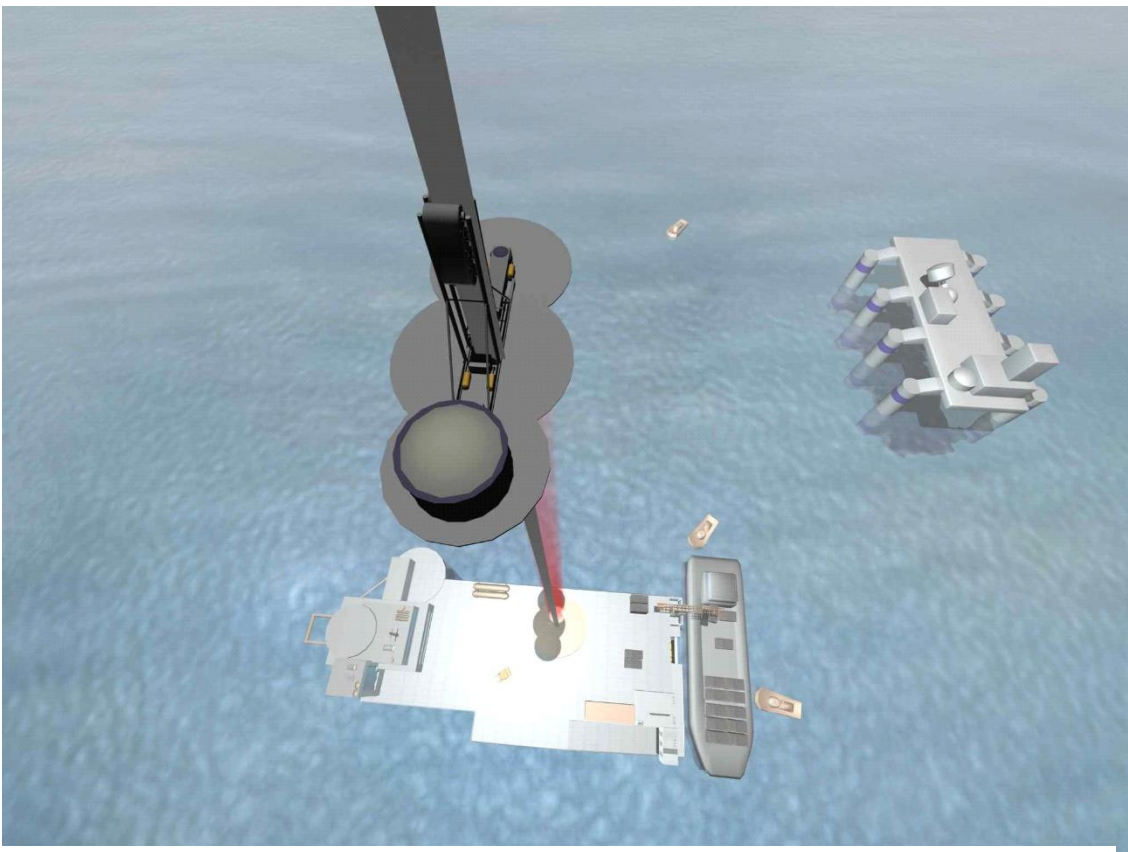


↑Multi-walled carbon nanotube (<http://s-renaissance.com/sites/default/files/imagecache/400x400/banner.jpg>)

4.Meeting at Cambridge

I visited Trinity College to meet and talk with Professor Alan Windle. Professor Windle was a very kind English gentleman and

talked with me a lot and took me around the college. The professor told me that many scientists are looking at carbon nanotubes as thermal conductors not wires of the space elevator. Professor Toshio Iijima also disagreed with the idea that carbon nanotubes can be utilized as a wire. Both of two professors disagreed strongly and talked about CNT's possibility as a thermal conductor and the reason it will be hard to make a use of them as its main wire. Both of the two professors told me that there'll be so many technical, physical and chemical problems when you want to utilize carbon nanotubes as its main wire, so I think it will be long time until space elevator's construction is over and the cost of launching satellites and travelling to space is made cheaper than today.



Terminal of Space elevator (CG)



Terminal in the outer space (CG)



↑ *Trinity College (by the author)*



↑ *Professor Alan Windle and I at Trinity College*

References

<http://www.org-chem.org/yuuki/nanotube/nanotube.html>

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[tbn0.gstatic.com/images?q=tbn:ANd9GcSLS1lFaZoD2S9_M5SMXOTJ4fbx-FwmgeDly0T_hZO6lrk9DtEB](https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSLS1lFaZoD2S9_M5SMXOTJ4fbx-FwmgeDly0T_hZO6lrk9DtEB)

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renaissance.com/sites/default/files/imagecache/400x400/banner.jpg

[NEDO report All about Carbon Nanotubes\(Nikkan-kogyo publishing\) \(2016\)](#)

