

# **NANOTECHNOLOGY**

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# Nanotechnology

Research and technology development at the atomic, molecular or macromolecular levels, in the length of scale of approximately 1 - 100 nanometer range in at least one dimension [which creates and uses] structures, devices and systems that have novel properties and functions because of their size – U.S.P.T.O., Class 977 definition.

- **Top-down nanotechnology**: making nanoscale structures by starting with a bulk, non-nanoscale material and creating nanoscale structures in it, eg. by machining or etching.
- **Bottom-up nanotechnology**: making nanoscale structures from nanoscale building materials, eg. building chemical structures molecule by molecule.

# Nanotech Products

- improved antimicrobial wound dressings employing silver nano crystals.
- improved textiles with nano whiskers which resist staining.
- cosmetics with improved absorption properties.
- “metallic rubber” with electrical conductivity and the flexibility of rubber.
- tennis racquets with improved flex resistance.

# Class 977

- (a) The novel and differentiating properties and functions of disclosures in this class are developed at a critical length scale of matter, typically under 100 nanometers.
  
- (b) Nanotechnology research and development includes manipulation, processing, and fabrication under control of the nanoscale structures and their integration into larger material components, systems and architectures. Within these larger scale assemblies, the control and construction of their structures and components remains at the nanometer scale.

## Class 977 cont'd

- (c) In some particular cases, the critical length scale for novel properties and phenomena may be less than 1 nanometer or be slightly larger than 100 nanometers.
- (d) The novel properties or functions, e.g., special effects, are attributed to and are intrinsic at the nanoscale.

Note 2: A compound, an element or a composition of matter of nanoscale dimensions is not per se placed in Class 977. They will only be placed in Class 977 if they have particularly shaped configurations formed during manufacture which impart special properties attributed to the nanoscale. The example of a Class 977 molecule given is fullerenes.

Note 3: Mere differences of scale have to be distinguished from special attributes due to nanoscale. An example given is an electrical conductor of nanoscale width whose electrical properties are substantially the same as those of a conductor of larger width – not Class 977 – and a conventional conductor which exhibits quantum confinement or superconductivity only when width is nanoscale – Class 977.

# Types of Claims

- Product or composition of matter claims
- Machine or apparatus claims
- Process claims
- Product-by-process claims

# U.S.P. 6,344,272

1. A nanoparticle comprising at least one non-conducting core layer and at least one conducting shell layer, said shell layer independently layered upon said core layer, such that the thickness of said shell layer is independent of the radius of said core layer wherein the thickness of said shell layer is less than that of a shell layer whose dielectric properties are described by a bulk dielectric function of a material comprising said conducting shell layer and is not limited to account for the bulk dielectric properties of a material comprising said conducting shell layer said nanoparticle having a wavelength extinction maximum between 300nm and 20mm.

# U.S.P. 6,882,051, issued April 19, 2005

1. A nanowire, comprising:
  - a first segment of a first material; and
  - a second segment of a second material joined to said first segment;wherein at least one of said segments has a substantially uniform diameter of less than approximately 200nm; and
  - wherein said nanowire is selected from a population of nanowires having a substantially monodispersed distribution of diameters.

# U.S.P. 6,875,274, issued April 5, 2005

1. A heterostructure comprising a carbon nanotube covalently linked to at least one nanocrystal.
2. A method of producing a nanotube-nanocrystal heterostructure comprising covalently linking a nanocrystal to a carbon nanotube wherein a nanotube-nanocrystal heterostructure is produced.

# U.S.P. 6,940,088, issued September 6, 2005

1. A molecular structure, suitable for use as an electrical device having control properties, comprising:
  - a central nanotube of a zigzag type interconnected between two nanotubes of an armchair type.
  
11. A method of forming a molecular structure according to claim 1 comprising:
  - connecting a first end of a zigzag type nanotube to an end of an armchair type nanotube; and
  - connecting a second end of the zigzag type nanotube to an end of a second armchair type nanotube.

# U.S.P. 6,927,069 issued August 9, 2005

1. A probe comprising:
  - (a) a semiconductor nanocrystal which emits light when excited;
  - (b) a linking agent, linked to the semiconductor nanocrystal; and
  - (c) an affinity molecule linked to the linking agent.

# U.S.P.6,530,944, issued March 11, 2003

1. A method for inducing localised hyperthermia in a cell or tissue comprising the steps of delivering nanoparticles to said cell or tissue and exposing said nanoparticles to infrared radiation under conditions wherein said nanoparticles emit heat upon exposure to said infrared radiation.

# CA 2,405,735 – pending application

1. A hair treatment preparation comprising a payload in an intimate relationship to a polymeric nanostructure, the polymeric nanostructure being reactive to hair or capable of being immobilized onto or in hair.
10. A method of treating hair which comprises applying a hair treatment preparation to the hair, the hair treatment preparation comprising a payload in an intimate relationship to a polymeric nanostructure, the polymeric nanostructure being reactive to hair or capable of being immobilized onto or in the hair; and changing the conditions such that the payload and nanostructure are attached to the hair.

# U.S. Nanotechnology Patents

2003 : almost 1600  
2005 : Class 977/Dig. 1  
1380 patents  
~300 applications

# Conclusions

- Searching for nanotechnology prior art is a challenge, although efforts such as U.S. Reference Classification 977 will help
- Patentability must rest on something more than mere miniaturisation
- Early broad U.S. patents are likely to lead to litigation once commercialisation proceeds further
- In the chemical/biochemical arena, many amazing products and intellectual property challenges lie ahead.