Using Nanotechnology to Improve the Healthcare Clothing Performance

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Abstract:

The study aims to benefit from nanotechnology in improving the functional performance of therapeutic clothing, and the study was conducted using the graphene to improve the conductivity and the antimicrobial effect of therapeutic garments to be more suitable for muscle activation. The Nano-Prometric carbon molecules were prepared using the modified manure method of producing graphite oxide and then thermonuclear reduction to convert the graphene oxide into a graphene and carry out tests. Then test the graphene by Raman, XRD, TEM, and FTIR.

Subsequently, the graphene was applied to the fabric using string dyes and printing in color and all experiments were conducted on a mixture of dark-colored tissue (50% / 50% cotton / polyester) and 100% white spinning, using different concentrations of graphene. The printing technology of the Acrylate dough is installed in all samples using the hot air dryer.

Then carry out the laboratory tests of: Square meter weight, fabric breathability of water, air flow, electrical conduction, antimicrobial resistance of these types of bacteria such as GRAM Positive (s. aureus, B. subtilis) and gram negative (E. coli and protein) - friction resistance. For a change in the properties of treated fabric and to determine the best concentration of Nano-Prometric graphene, the garment is suitable for muscle stimulation, and for the surgeon to perform the required muscle stimulation performance the Arduino Nano has been used to cause the desired quantum vibrations to be adequately treated.

Keywords

Nanotechnology| , Nanometer graphene, healthcare

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Introduction:

There is no doubt that serious scientific studies must keep pace with the age of technology and technical and cognitive openness, where Nano culture and its applications revolutionized many industrial fields, which has led to attract the attention of workers in different fields of research, it is a promising technology that promises a huge leap in all branches of Science by arranging the molecules of matter next to each other in an unimaginable way and at the lowest possible cost, and this is related (to therapeutic clothing), for example the use of graphene Nano metric oxide in health care, so the current research has addressed therapeutic clothing for people through the stimulating activity of the muscles during physical therapy using nanotechnology that adds to the material the property of electrical conduction using graphene as this accelerates the process of time and reduces the number of visits to treatment centers and the implementation of a simple model of sports training suit that commensurate with the nature of exercising.

1-2 The problem of the search: - The problem of the research is summarized in the following questions: -

Q1: How can nanotechnology be used in the production of therapeutic clothing?

Q2: How can nanotechnology be used in therapeutic clothing to increase the effectiveness of physiotherapy?

Q3: How can i improve the functional performance of fabrics used in therapeutic clothing?

1-3 The importance of the research: -

1- Production of therapeutic clothing using nanotechnology.

2- Contribute to the provision of scientific and academic study to link nanotechnology and the garment industry.

3- Taking advantage of the scientific development to spread the concept of therapeutic clothing within the Arab Republic of Egypt.

1-4 The rsearch goals: -

- Study the characteristics and applications of nanotechnology and the extent to which it can be used in the production of therapeutic clothing.

Search terms: -

Nanotechnology: Nanotechnology"

Nanoparticle technology, micro-technology or nanotechnology is the science that is interested in studying the processing of matter on the atomic and molecular scale, nanotechnology is interested in inventing new technologies and methods measured in nanometers, which is part of a thousand micrometers, a fraction of a million millimeters.

Therapeutic Clothing: Healthcare"

Health is maintained or improved by prevention, diagnosis and treatment of the disease and other physical disabilities in humans. which is working on an alternative treatment for what is currently being followed.

Carbon (graphene)

A carbon-related material, two-dimensional crystalline hexagonal structure (also called honeycomb or chicken wire). It is the thinnest material ever known to date, its thickness is equivalent to only one carbon atom.

Nevertheless, it is considered one of the most powerful known materials. It has a high electrical delivery efficiency that rewards copper connectivity and is the best heat conductor ever. Graphene is almost transparent and absorbs only 2.3 of light, yet it is also too dense to allow it to cross the smallest helium atom through its hexagonal structure،

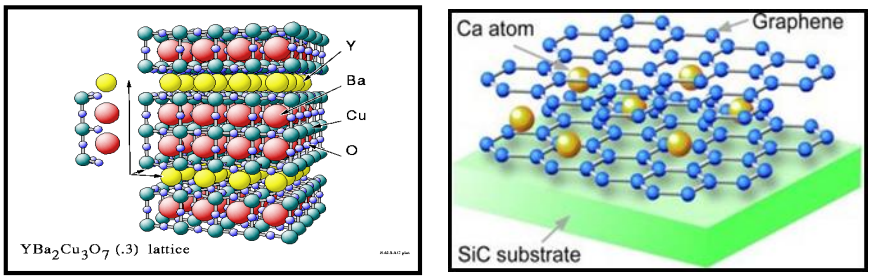

Figure (1) for carbon (graphene)

Nanotechnology: Is a technology based on the reduction of granules or the magnification of small materials to be below 100 nanometers and is the smallest unit of measurement of dimension that man has been able to measure to date, and when manufacturing Nano-sized materials the chemical and physical composition of the raw materials used in manufacturing plays an important role in the properties of the resulting nanomaterial, there are two ways to manufacture the size of Nano nuclei in the material: the first way from top to bottom: in which the construction units are reduced to the nanometer level. Building units by inserting individual atoms or molecules into interactions to form chemicals and biological materials, and then introducing these materials into the construction of Nano metric components.

-Nanomaterials shapes:

When manufacturing Nano-sized materials, the physical composition and chemical concentration of raw materials used in manufacturing play an important role in the properties of the resulting nanomaterial, unlike what happens when manufacturing ordinary materials.

The most important of these forms are:

1. Nanoballs. 2. Nanotubes.

3. Nanowires. 4. Quantum dots.

5.Nano Fibers 6-Nano Particles

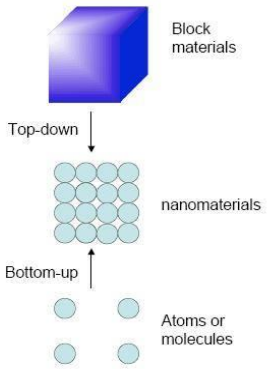

Figure (2) method of manufacturing the nanoscale size of the material

-Characteristic of nanoparticles:

Electrical conductivity - hardness - ability to change color – transparency

What is graphene?

Graphene is a single layer of carbon atoms, bound together in repetitive hexagonal patterns, and graphene is about a million times thicker than a normal sheet, so it is thin enough to be considered the only two-dimensional material detected so far.

These layers of carbon atoms are the basis of other important materials, where graphite is formed when graphene is accumulated on top of each other, and carbon nanotubes, another emerging material, are made up of rotating graphene, which are used in bicycles, tennis rackets and even in living tissue engineering.

Nanotechnology applications in textiles:

- UV protection. - Resistance to dirt.
- Resistance to flames. - Control humidity.
- Resistance to bacteria. - Resistance to static electricity.

Figure (3) Applications of nanotechnology in textiles

Smart Textiles:

- **Smart textiles are known:**

They are textiles that can feel and interact with the surrounding environmental conditions from mechanical, thermal, chemical, electrical or magnetic sources and adapt to them by integrating functions in the structure, as they are able to sense external conditions (stimuli) and respond to it in a predetermined way.

The mutual relationships between modern clothing technology:

This refers to the term "textronics" to multi-disciplinary approaches in the production and design of textile materials, where science aims at a branch of modern science to strengthen the foundations of the technological field that connects textiles, electronics and knowledge.

Here, the wearable technology itself contains two subsets of interest:

1- First: Wearable Computer

They are the traditional devices carried on the body that are more based on data processing using the surfaces of computer screens and the second: like smart clothing and devices integrated with clothing that increase the degree of functionality of clothing or affect the function of processing information Using clothing.

Figure (4) Therapeutic smart clothing

Electronics from wearable industries such as:

•Medical clothing and healthcare. • Sports clothing and fitness.
• Electronics Consumers. • Defense Applications.
• Sports and health care.

5-4 smart raw materials:

A polymer or smart matter can be described as a substance that changes its properties depending on the external conditions or triggers.

Smart clothes are used for special categories and multi-domain:

1- Space clothes. 2- Sports wear

3- Military clothing. 4. Cosmetic textiles.

5- UV protection clothing. 6- Chemical protection clothing.

7- Medical applications (including medical drug delivery systems - bed sensors - sweat detectors - smart bandages to support bones).

The treated part of the human body:

Upper limb structure: consists of shoulder strap, arm, forearm and hand. The shoulder and peritoneal bone are the bones of the shoulder strap, the humerus bone, the arm bones, the heel bone and the ulna bone, while the skeletal of the hand consists of the wrist, hand comb and phalanges.

1-triceps 2-shoulder bone 3-humerus 4-the ulna -5carpals bone 6-wrist 7- hand comb 8-scapula.

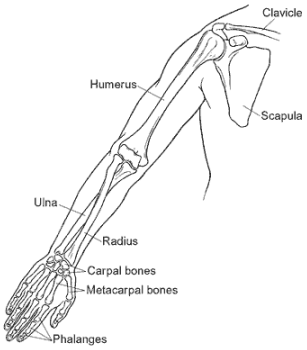

Figure (5) the great hand and arm skeleton

The table shows the results of the tests performed on the treated material

No	The image of the material in the treatment	Inhibition Zone				Conductance, Siemens (µS)	Fastness to rubbing		Concentration of graphene %	Weight gr	Type of material
		Gram Positive		Gram Negatve							
		S. aureus-	*B. subtilis-*	*E. col*	*Proteu-*		Dry	Wet			
1		0	0	0	0	6.89×10^6	3-4	2-3	**0.07**	2.300	Jersey
2		7	8	8	7	12.5×10^6	4	2-3	**0.10**	2.300	
3		14	15	12	13	23×10^6	4	2	**0.13**	2.300	
4		16	15	13	14	0.03×10^7	4	2	**0.16**	2.300	

5		18	19	18	18	0.63×10^7	4	2-3	**0.20**	2.300	
	Ciprofloxacin	26	25	22	23	Figure (7)	Figure (8)				
		Figure (6)									

The relationship between the Graphene concentration and Inhibition Zone (before washing)-:

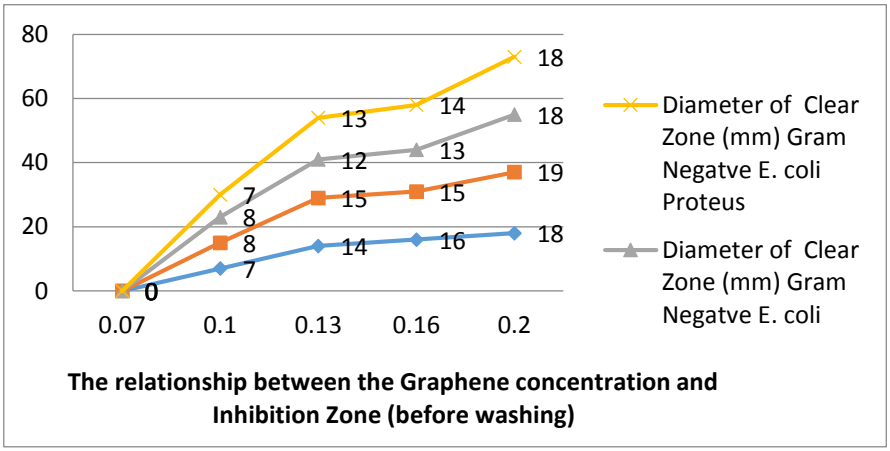

Figure (6) Inhibition Zone

From the illustrated tables and figures we noticed that: the efficiency of grapheme as anti-microbial has increased with the increase of graphene concentration in all types of bacteria and the best result was achieved at concentration of 0.2% even after or before washing, also it was noticed that the application technique of graphene onto the fabric with colorless binding agent showing a very good wash-fastness.

The relationship between the Graphene concentration and Conductivity (before washing)-:

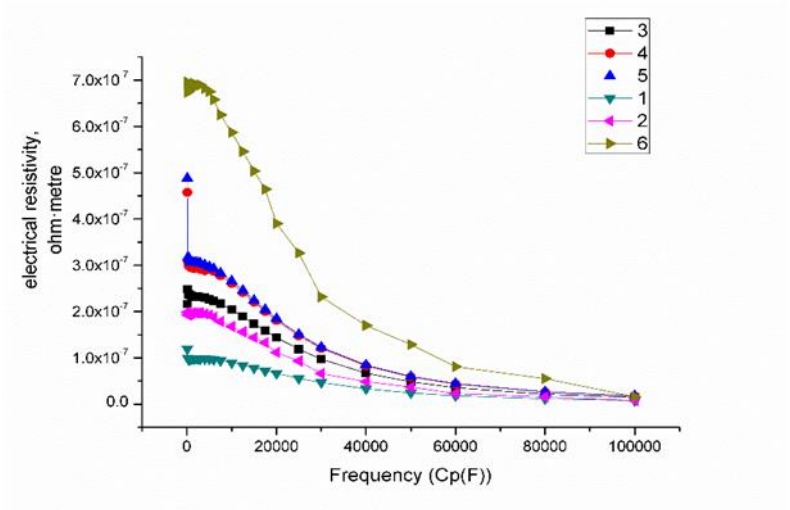

Figure (7) Conductance, Siemens (µS)

The illustrated tables and figures showing that the conductivity of graphene was increased with the increase of graphene concentration and the best result was achieved at concentration of 0.2%. Also it was noticed that/; the same results were achieved even after washing meaning that the binding agent which was used showing a very good adhesion power to the fabric.

The relationship between the Graphene concentration and Fastness to rubbing(Dry-Wet):

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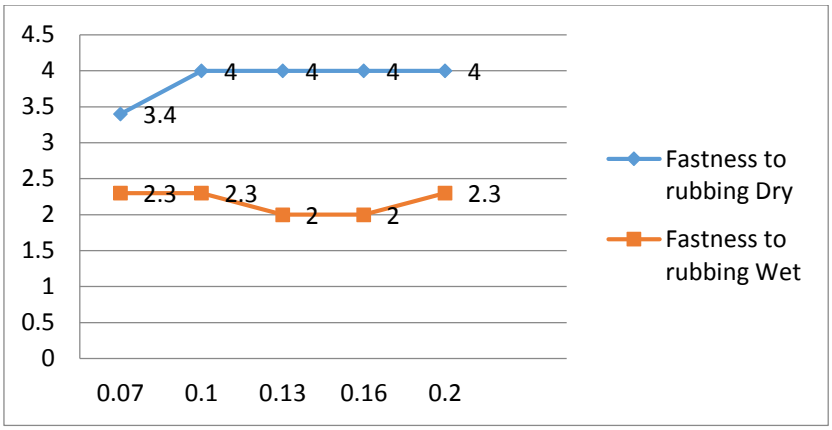

Figure (8) Fastness to rubbing

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