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The role of nanotechnology in disaster prevention

Research Project

Submitted to the department of General Science in partial fulfillment of the requirements for the degree of BSc. In General Science

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Supervisor Approval

I support that this research has been completed and written under my supervision and, I agree that it will be presented in its current form for discussion to obtain a bachelor's degree for each student.

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Chapter One

1-1 Introduction

Before the emergence of nanotechnology, scientists were interested in minimizing the materials used in the manufacture of electrical and electronic devices until they reached the micrometer scale. Hence, the term micro appeared in many names such as the microscope, microwave, microphone, microporsor and other names related to precise devices. However, science after Richard Feynman has produced what is smaller than a micrometer to become at the nano level, and the term nanotechnology began to be used to replace the micro technology, so devices became smaller and more efficient.

There are nano processors and nano-coating, nanomedical preparations and nano-fabrics, all of these names appeared for the development of nanotechnology and became made of new nanomaterials. Nanotechnology is building new materials, devices, and systems by manipulating matter at the nanoscale and exploiting new properties.

Nanotechnology can be defined as the science that deals with the study and manipulation of matter on the atomic and molecular scale. They are dimensions much less than the dimensions of bacteria and a living cell and are concerned with the properties of materials. Where we can replace an atom of an element and replace it with an atom of another element, and thus we can make something new from almost anything. Sometimes these materials surprise us with new properties that we did not know before, which opens new areas for their use and harnessing for the benefit of humans, as happened before that when the transistor was discovered.

Chapter Two

2-1 Nanotechnology

We know that atoms gather to form materials in their known state to get iron, gold, diamonds and other known materials and compounds that we use in our daily lives. These materials and compounds are found in nature in their known form. Through scientific studies and research, we got acquainted with its atomic structure and studied its properties to become one of the basic materials in our lives on which industries and technologies are based that make human life easier and more luxurious.

The building block of material is the atom. The atom is infinitesimally small, as if you put 10 million hydrogen atoms side by side, its length is 1 millimeters. American scientist Richard Feynman in 1959 scientist put forward his vision of the possibility of changing the properties of any substance if its atoms were rearranged because the properties of materials depend on their composition and crystal structure, and what Feynman was talking about was as if it was a science fiction that scientists did not believe at the time, because at that time there was no way by which the atom could be moved in the material with a diameter of less than one nanometer and moved from place to place and rearranged.

In the year 1981, the two scientists Heinrich Rohere and his colleague Gerd Bininig the two researchers at IBM invented the Tunneling Microscopy Scanning (STM), which enabled them to directly deal with the single atoms of the material and determine its three dimensions through a very fine needle that can apply negative electric charges to sense the atoms on the surface of the sample under study Figure (2-1) and determine the shape and arrangement of the atoms in it. The two scientists were able to write the name of the company in which they work with the xenon atoms on a nickel chip as shown in Figure (2-2). [1-5]

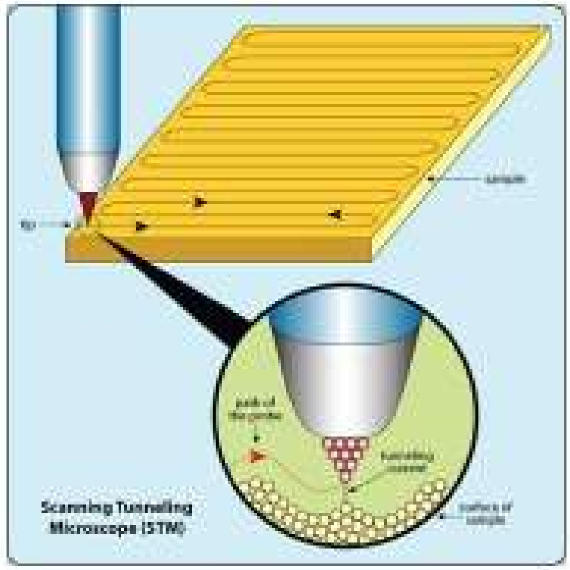

Figure 2.1: Illustrates the idea of scanning tunneling microscope needle work.

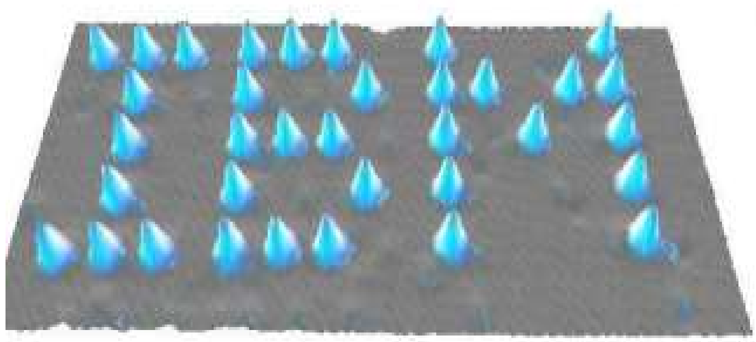

Figure 2.2: The IBM logo written with Xenon element atoms on a chip of nickel.

This invention was what the scientist Feynman was waiting for, as his theory moved from science fiction to a tangible reality that can be achieved. Feynman did not know that with his ideas he had sparked the first revolution of the twenty-first century, which he called the world Japanese Norio Taniguchi of the year with Nanotechnology.

Scientists have predicted a promising future for this technology, which actually began in 1990, and that industrialized countries are pumping millions of dollars to develop it. Japan's funding to support nanotechnology research for the year (2006) has reached one billion dollars. As for the United States, there are 40,000 American scientists working in the field of nanotechnology, and the American budget provided for this science is estimated at one trillion dollars until the year 2005.

Nanotechnology is the fifth generation of electronics in the 21st century. Where the first generation relied on electronic lamps that were used in radio and television sets, and the second generation relied on the transistor, which replaced large electronic lamps with small electronic pieces that enabled From the manufacture of smaller devices with higher efficiency and replaced the technology of electronic lamps with transistors, then entered the third generation, which relied on integrated circuits, reduced the size of many devices and increased their efficiency. The computer and communication devices we use now. [1-5]

2-2 Nano Term

Before we explain what nanotechnology is, let's first get acquainted with the term nano. This term is mainly derived from the Greek word nanos, which means little dwarf and is used to denote one billionth of a meter.

1 centimeter equals one hundredth of a meter

1 millimeter equals one thousandth of a meter

1 micrometer equals one millionth of a meter

1 nanometer is equivalent to one billion (one thousand million) parts of a meter

Hence, we note how small one nanometer is, as a meter is equivalent to 1000 million nanometers, and a nanometer is equivalent to the length of 13 hydrogen atoms next to each other as in Figure (2-3). [1-5]

Figure 2.3: shows the number of nanometers through 13 hydrogen atoms with a diameter of each atom Equivalent to 0.75 nm

Another example to illustrate the smallness of the nanoscale is the diameter of a human hair, which is on average 100 micrometers, which is equivalent to on the nanometer scale equivalent to 100,000 nanometers, and the diameter of the red blood cell is 2.5 micrometers, which is equivalent to 2500 nanometers, while the length of bacteria is 1 micrometers, which is equivalent to 1000 nm.

The nanometer unit was used as a unit of measurement for the length of very small things that can only be seen by electron microscopy. It is used to express the dimensions and radii of atoms and as a measure of cells and microscopic particles.

2-3 The importance of nanomaterials:

Nanotechnology depends on nanomaterials. Interest in these materials is increasing due to their distinctive and new properties. When the material is in a size less than 100 nanometers, it appears to have new properties that are often contrary to its known properties in its natural form. This difference is due to the properties for two main reasons [1-5]:

a- Surface area.

b- Quantum effect.

To illustrate the importance of surface area in nanomaterials, let us imagine a cube with a side length of 1cm. The volume of the cube is $1cm^3$, the total surface area of the cube is $6cm^2$. When this cube is divided into two parts, its surface area will be $8cm^2$ while its size remains constant, and imagine what happens if the cube is divided into a million parts, the surface area of all small cubes will be enormous in relation to its size, and this means that the atoms that have become on the surface of the material more as the material is divided into finer parts, as in Figure 2.4

As for the quantum effect, it clearly shows that these materials are no longer subject to the laws of classical physics because of their small dimensions that are close to the atomic dimensions, so they are subject to the laws of quantum physics, which is reflected in their properties.

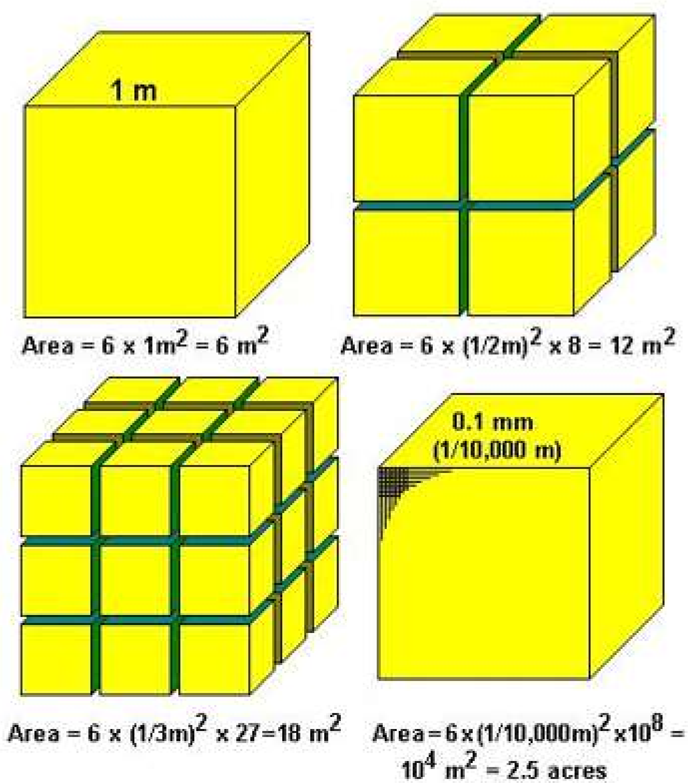

Figure 2.4: Increasing the surface area with Divide the cube into several parts

When the surface area of a substance increases, the number of its atoms on the surface increases, as in Figure 2.5, and this increases the substance reacts and becomes of higher chemical activity. The surface atoms of any material are responsible for chemical reactions with other atoms because they have unpaired electrons inside the material. This explains the activity and activity of any nano-material from its normal state, as well as changing its electrical, magnetic, thermal and mechanical properties.

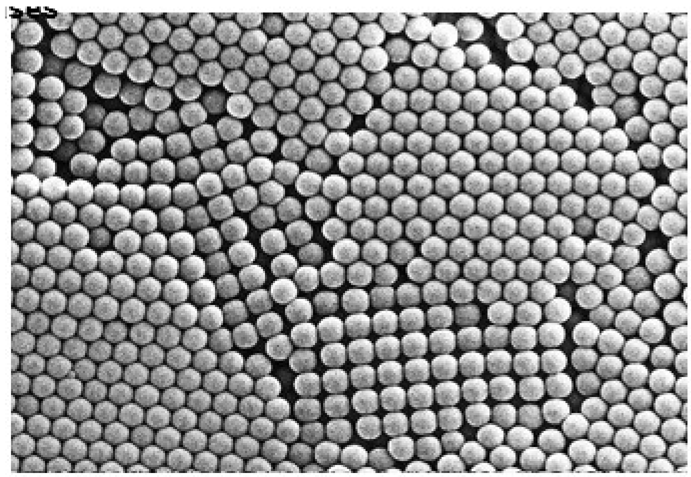

Figure 2.5: Shows the increase in the number of atoms Surface in nanomaterials

2-4 Properties of nanomaterials:

The physical and chemical properties of nanomaterials such as color, strength, hardness, chemical activity, electrical conductivity, and thermal properties vary. [1,3,5-6]

2-4-1 Mechanical properties of nanomaterials:

The properties of materials change at the nanoscale due to the small size of the grains that make them up, and its effect on increasing the surface area in relation to the size, so the hardness of metallic materials increases and their resistance to stress increases. Ceramic materials also gain strength that ceramic materials,