

Brief for GSDR – 2016 Update

Nanotechnology and sustainable development in Iraq

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1. Introduction

Nanotechnology is a term that describes the field of science that studies and manipulates the properties of materials at a scale of less than 100 nanometers (Murashov, 2011). At this size material display unusual properties and can be fabricated to achieve significantly better properties than can be achieved by manipulating materials on a larger scale (Borisenko, 2008). During the past decade, nanotechnology has globally become a core technology, projecting the future direction of science and engineering as well as the industry, it has emerged as a versatile platform for addressing global sustainability challenges facing the world (Diallo, 2014). Nanomaterials exhibit key physicochemical properties that make them particularly attractive as functional materials for sustainable technologies (Dhingra, 2010). On a mass basis, they have much larger and more active surface areas than bulk materials. Nanomaterials can be functionalized with various chemical groups to increase their affinity toward a given compound including dissolved solutes and gases. Nanomaterials are also providing unprecedented opportunities to develop functional materials with superior electronic, optical, catalytic and magnetic properties (Bhushan, 2012; Vasileska, 2010).

The development of nanotechnology in any developing country such as Iraq must begin with a government supported nanotechnology initiative. Recently Ministry of Science and Technology (MOST) in Iraq has established the first building block for nanotechnology researches and rapidly this very small step has become today one of the most important reference lab in the characterization of nanomaterials in the country, and was able to support hundreds of researchers and postgraduate students working in this field, but also this step need more support and encouragement from the government in order to continue and grow, and to be able to contribute in the areas of sustainable development.

2- Key Applications of Nanotechnology

Nanotechnology have contributed to the development of many industrial fields that may address global challenges in; water purification (Mishra, 2014), clean energy technologies (Zang, 2011), greenhouse gases management, materials supply and utilization (Smith, 2011), and green manufacturing and chemistry. Many actual examples exist on the use of nanomaterials in the industry, such as:

Aerospace

- Lighter and stronger materials for aircraft.

- Coatings materials for radiation shielding.

Chemicals & Advanced Materials

- Highly efficient catalysts.
- Membranes and filters.
- Hard coatings for corrosion and scratch resistance.
- Efficient lubricants.
- Nanocomposites materials.
- Thermal insulators and fire retardants.

Clean Energy

- Efficient materials for photovoltaics solar cells.
- Improving materials for fuel cells.
- Higher performing batteries.

Electronics & Photonics

- Tiny computer processors.
- High density data storage.
- Fast optical communications.
- Enhanced display technologies.
- Tiny sensors.
- Enhanced and efficient new LEDs.

Medical & Pharmaceutical

- Drug delivery to target diseases.
- Diagnosis of diseases.
- Biocompatible restorative materials.
- Real time monitoring using Bio MEMS devices.

Water Purification

- Nanomembranes for purification.
- Nanocatalysts and nanomagnetic particles for cheaper desalination.
- Nanosensors for detecting contaminants in water.

3. The Future of These Technologies

The scientific community agrees that the driving force for scientific progress is linked strongly to progress in two areas: genetic engineering and nanotechnology. Since genetic engineering are supported directly on the nanoscale technologies, it can be said: The nanotechnologies have the keys for scientific progress for the future, and this progress will change every aspect of human life in this world in an amazing manner.

The future of nanotechnology was and still is the subject of several publications and probably exceeded some of science fiction limits. In this technology we can assemble different atoms to acquire new properties that not previously exist, it will be possible, for example, making cloth that may repairing itself when it subject to tearing, and it could locate the place of injury to the wearer, who could be a policeman or soldier or fireman, and it can send a message to the center with the necessary information, such as pulse, temperature and blood pressure and then it may release an appropriate dose of medicine in the body, with the light weight of these clothes it may serve as a powerful shield against external influences (Schult, 2005).

Expectations in the field of computers has no limits, but the development can be expected at two levels the first development of a very small devices with better performance and higher capacity of the data processing, and the second related

to the development of tiny machines called Nanobots expected to reach the worlds of unexpected, such as blood vessels or living cells and could be move to a very dangerous sites, for example, can provide information about volcanoes, hurricanes or information from outside of the atmosphere (Allhof, 2008).

In the industry the nanotechnologies promise to provide versatile smart materials such as smart coatings that possess the ability to power generation and processing of environmental pollutants and produce oxygen and characterized by its ability to self-cleaning and fight the bacteria as the colors may vary depending on the light falling on them (Ramsden, 2014).

4. Position of Iraq in This Area

Unfortunately, an accurate data on Iraq investments in the field of nanotechnology are unavailable, however, depending on the number of scientific research publications available on the Internet, Iraq is ranked as No. 54 in the world. This rank is low and does not reflect the actual reality of the research in the field of nanotechnology, because most Iraqi magazines are unavailable on the Internet, while these magazines are filled with many of the research and studies related to the fields of nanotechnology, and at recent years there have been several research centers and scientific departments have been establishment almost in every Iraqi universities and scientific institution.

5. Future Vision of nanotechnology in Iraq.

Iraq has all the necessary resources to create a solid scientific base concerned with research and applications of nanotechnology, and perhaps, if this base will properly build, Iraq will not be able to stand with the other countries but may outperform many countries that have preceded us in this area. Iraq has very high rates of economic growth as well as the availability of a great scientific potential and this will necessary means there will be a real opportunity for the developing and growth of nanotechnology in this country.

6. Role of MOST in Developing Nanotechnology in Iraq.

Ministry of Science and Technology (MOST) is the main institution in Iraq that concerned with the development of scientific technology in general and nanotechnology in particular, as it has all the qualifications that make it the sponsor in the country for developing and application of these vital technologies. It is worth to mention that the ministry researchers annually produce dozens of research studies and contribute to the enrichment of most national events such as conferences, seminars and workshops held by various state institutions that deal with the areas and applications of nanotechnology.

Also, few years ago the ministry have started to establish a specialized laboratory for the research and application of nanotechnology, at the Directorate of Materials Research (DMR). Although the laboratory is almost reach the final stages of the planned period to complete, but it

has become today one of the most important reference LAB in the characterization of nanomaterials in the country, and was able to perform annually thousands of measurements to various researchers and postgraduate students.

7. How to Support nanotechnology in Iraq?

Most nanotechnologies are considered advanced and modern techniques and necessarily require the presence of very sophisticated equipment and facilities, and the products of nanotechnology research may not appear instantly or in short time, but instead it may require long periods of the research study, so most countries in the world resort to the government support to cover the long-term needs, for example, the United States of American allocate billions of dollars annually to support the US national Nanotechnology initiative program, a program is directly linked to the US president, as did like Russia, Australia and a number of large European countries. This is precisely what we need in Iraq, as it must have a vision and a unified national support for research and studies in this area and to encourage innovations and inventions in various fields.

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