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Controversy in the Use of Nanomaterials

Maria Richert* and Marek Dudek

Management Faculty, Poland

Abstract

This study presents the possibilities of using nanomaterials, including in medicine. The characteristic features of nanomaterials and the prospects for their use in various fields of the economy were indicated. The dangers of nanometric particle sizes of nanomaterials in their application in medicine have been highlighted. The discovery of the existence of nanomaterials and the possibility of their production now offers interesting prospects for their use.

Keywords: Nanomaterials; Nanotechnology; Medicine

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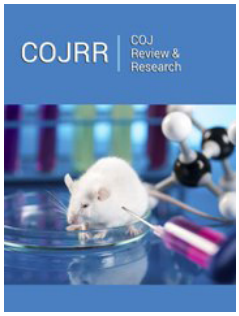

***Corresponding author:** Maria Richert, Management Faculty, Kraków, Poland

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Introduction

The history of nanomaterials in science began in 1956, when Richart Feyman introduced the possibility of combining individual atoms and building of these elementary particles of selected matter. In turn, the term nanotechnology was first used in 1974 at the University of Tokyo. Eric Drexter is considered to be the father of nanotechnology.

Nanomaterials are currently produced and used in many areas of the economy. Among the numerous applications of nanomaterials, e.g., as an additive to paints, surface coatings, for the production of self-cleaning windows and others, nanomaterials are also used in medicine. This type of biomaterials includes silver, gold and copper, which have a bactericidal and even antiviral effect. However, the bactericidal properties of silver have been known for centuries. Medieval sailors threw silver coins into water barrels to protect themselves from infection [1-3].

Therefore, the discovery of the existence of nanomaterials in nature since the dawn of time (e.g., in soot) should be included in the next step in learning about the world and its ubiquitous impact on phenomena that people encounter. Thanks to this discovery, there was widespread awareness of the existence of nanomaterials. Certain scientific activities and practical activities have been focused on their production and, where possible, using their specific properties [4-6].

Nanotechnology has also found potential application in the fight against cancer. A way to bypass the phenomenon of resistance or improve the anti-cancer properties of therapeutic compounds is to develop new delivery systems, and nanoparticles may be useful in this regard. The nanoparticles used in medicine include, among others: liposomes, micelles, microcapsules, dendrimers, nanotubes. It is a group of the best-known carriers of biologically active substances. It is now known that nanomaterials have not only benefits but also a potential danger. Interaction of nanomaterials with the immune system can potentially lead to the immunosuppression, hypersensivity (allergy), immunogenicity and autoimmunity, involving both innate and adaptive immune responses. Therefore, the use of nanomaterials in medicine requires long-term research and recognition of the effects of their use. Despite these controversies, the use of nanomaterials in medicine is increasing, especially in the field of diagnostic research. For example, semiconductor nanocrystals or Quantum Dots (QDs) are attractive for tumor imaging, which possess a broad excitation bands and narrow emission bands. Nanomaterials are also used in Magnetic Resonance Imaging (MRI), replacing the traditional superparamagnetic iron oxides. Carbon nanotubes are used in photothermal therapy [7-9].

One of the most important discoveries in the field of nanomaterial science is the phenomenon of abrupt changes in physicochemical properties with radical fragmentation of matter down to a few nanometers. This is when quantum effects emerge, and the laws of quantum mechanics are used to describe them. The occurrence of these particular effects underlies the unique properties of nanostructures that distinguish them from larger-sized materials. Among other things, the changes taking place are spectacularly visible in the changes in the colors of objects, which have a completely different color at the micrometric size of the particles. Currently, the greatest progress in the synthesis of nanomaterials is related to the production of nanometric particles, which are used in particular in biomedicine, electronic storage devices and sensors. The size distribution of the produced nanometric particles is shown by the Gaussian curve. In the resulting volume, only a certain fraction of the particles will have the expected size. This also has to be taken into account when analyzing the phenomena resulting from the application of nanotechnology. The prospects for the development of nanotechnology are very promising however, they are burdened with numerous dangers related to the toxicity of nanomaterials. Achieving the most favorable properties of matter when fragmented to nanometric sizes requires further research both in terms of the methods of their production as well as the possibilities of their practical application. Numerous data show that the features of nanometric materials are and will be useful in the future, especially in medicine [10-13].

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