Chapter 11
Applications of Nanomaterials for Water Treatment: A Future Avenue

Anupreet Kaur
Punjabi University – Patiala, India

ABSTRACT

Development of new technologies, progressive urbanization, increasing consumerism and industrial boom in developing countries has led to elevated pollution of the environment. The spectrum of pollutants produced and released to the environment has increased in the last few decades including the agricultural, industrial, pharmaceutical and plastic industries. In the developed and underdeveloped countries where environmental pollution goes on increasing day by day, the concern of mankind to the threat of humanity increases which comes from anthropogenic degradation of the environment. An analytical chemist is always in search of cheaper, quicker, more sensitive, more reliable, precise methods of analysis. To achieve such a goal many properties of the materials are studied. Nanotechnology meets many of the conditions mentioned above and is very economic. So, analytical nanotechnology is an important tool for preconcentration and separation of pollutants at low levels.

INTRODUCTION

Rapid urbanization and industrialization of human civilization leads to the discharge of several hazardous contaminants and pollutants into aquatic streams, these effluents contains toxic wastes such as metals, organic impurities, etc., which directly produces
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a detrimental impact on the biotic resources (Mara 2003; Moore et al. 2003). The unmanageable discharge of pollutants and contaminants due to their severe toxicity and more carcinogenic nature as comparable to other water contaminants, metal ions can cause brutal health troubles for aquatic fauna as well as flora but it also troubles human health through the prevailing ecological food chain (Hutton et al. 2007). Thus, the instantaneous removal of these toxic pollutants from wastewater is a noticeable issue in the aerobic and aquatic world.

The severity of pure drinking water scarcity has to be looked at from two aspects: First, quantity of available water and second, the quality of drinking water. With the rapid development of industries, such as batteries, metal plating facilities, mining operations, fertilizers industries, tanneries, and pesticides (Lvovich 1979).

As nanotechnology continues to proceed steadily, the primary focus of the research agenda has progressively advanced from the fundamental discovery and characterizations to look into the opportunities of presenting nanotechnology and the resultant nanomaterials as the major key to address the challenges of improving global sustainability, particularly in a wide spectrum of pivotal areas involving energy and environment (Seckler et al. 2003).

The properties of nanotechnology innovations are overpowering. Nanoscience and nanotechnology inspired images of “science fiction” with the word invoking visions of technologies wonders such as atoms and molecules joining to create materials with extraordinary physical and chemical properties which can mimic all of the things developed by nature in millions of years. This great deal of optimism and global enthusiasm about “small” encourages developing a lot of nanosensors which are used for detection of various pollutants. Nanotechnology is the creation and utilization of materials and devices at the levels of atoms, molecules, clusters supramolecular structures and exploitation of their unique properties at the nanoscale. It has introduced these novel Nanomaterials including Nanoparticles into our environment. Environmental protection, water pollution, food safety and human health are major issues which need to be addressed as soon as possible. Nanotechnology endeavored to provide “smatter” materials used in environmental sensing and remediation of water pollution problem as well as protecting human health from various toxic materials. The advent of nanotechnology has given immeasurable opportunities to purify water even at ionic state. The various nanostructures materials have been fabricated with features such as high aspect ratio, reactivity, and tunable pore volume, electrostatic, hydrophilic and hydrophobic interactions which are useful in adsorption, catalysis, sensing, and optoelectronics. Nanotechnology, which literally refers to the manipulations of materials and processes that are engineered to the molecular scale of 1–100 nm, is an emerging field that poses immense ability to hierarchically construct materials from the bottom up approach to significantly improve the performance as well as add new functionality to the existing products. The evolutions
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