Chapter 1
Introduction to Environmental Nanotechnology: E-Nano

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ABSTRACT

With the advent of industrialization, there are new technological developments going on which have triggered the new researches and fields. Nanotechnology is one such field that is marked as twenty-first century industrial revolution and led to the development of various products that have impacted life in almost every field. Among these fields, nanotechnology has contributed significantly to the environment protection and its remediation by addressing issues that have been threatening the human for long. In this regard, several nanomaterials have been synthesized and many more are still in pipeline. No doubt the field has made great contributions and has bestowed human with various amenities by enhancing atom efficiency, use of fewer chemicals, less energy and other resource, reduction in waste, providing better materials, and technology for environmental applications promising environmental sustainability, however there are certain negative impacts that still need to be explored.

INTRODUCTION

Nanotechnology according to American Society for Testing and Materials (ASTM) International is defined as "a term referring to a wide range of technologies that measure, manipulate, or incorporate materials and/or features with at least one dimension between approximately 1 and 100 nanometers (nm); such applications exploit the properties, distinct from bulk/macroscopic systems, of nanoscale components" (Sellers et al., 2008). Owing to the manipulation of the properties and materials the field offers, Nanotechnology is considered 21st century industrial revolution. The term was initiated with an idea of Richard Feynman and is understood as a "technology at nanoscale" (Ramsden, 2011). With its multidisciplinary nature the field encompasses production and development of materials at atomic and

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molecular scales and their integration into large nanostructures. The resulting nanomaterials show different properties from their bulk counterpart which can be tailored as well due to their small size and high surface to volume ratio (Figure 1) (Karkare, 2008; Ratner et al., 2003).

The power of this small technology can be envisioned by the fact that it not only offers improved products but has also resulted in better manufacturing and technological processes in almost every field of life starting from simple house hold products to complex engineered materials (Karkare, 2008). In the environmental arena nanotechnology has contributed in multiplex ways and has significant impact on its sustainability. The chapter presents a brief overview of the role of nanotechnology in environment field.

E-NANO

According to the U.S. Environmental Protection Agency defines nanotechnology as "research and technology development at the atomic, molecular, or macromolecular levels using a length scale of approximately one to one hundred nanometers in any dimension; the creation and use of structures, devices and systems that have novel properties and functions because of their small size; and the ability to control or manipulate matter on an atomic scale" (Sellers et al., 2008; Tratnyek et al., 2006). The three major areas of environment in which nanotechnology plays its role are:

1. Environmental monitoring
2. Environmental remediation
3. Pollution prevention

These three traits of E-Nano along with the famous kinds of nanomaterials that have really bloomed these aspects are briefly overviewed in Figure 2.

Figure 1.