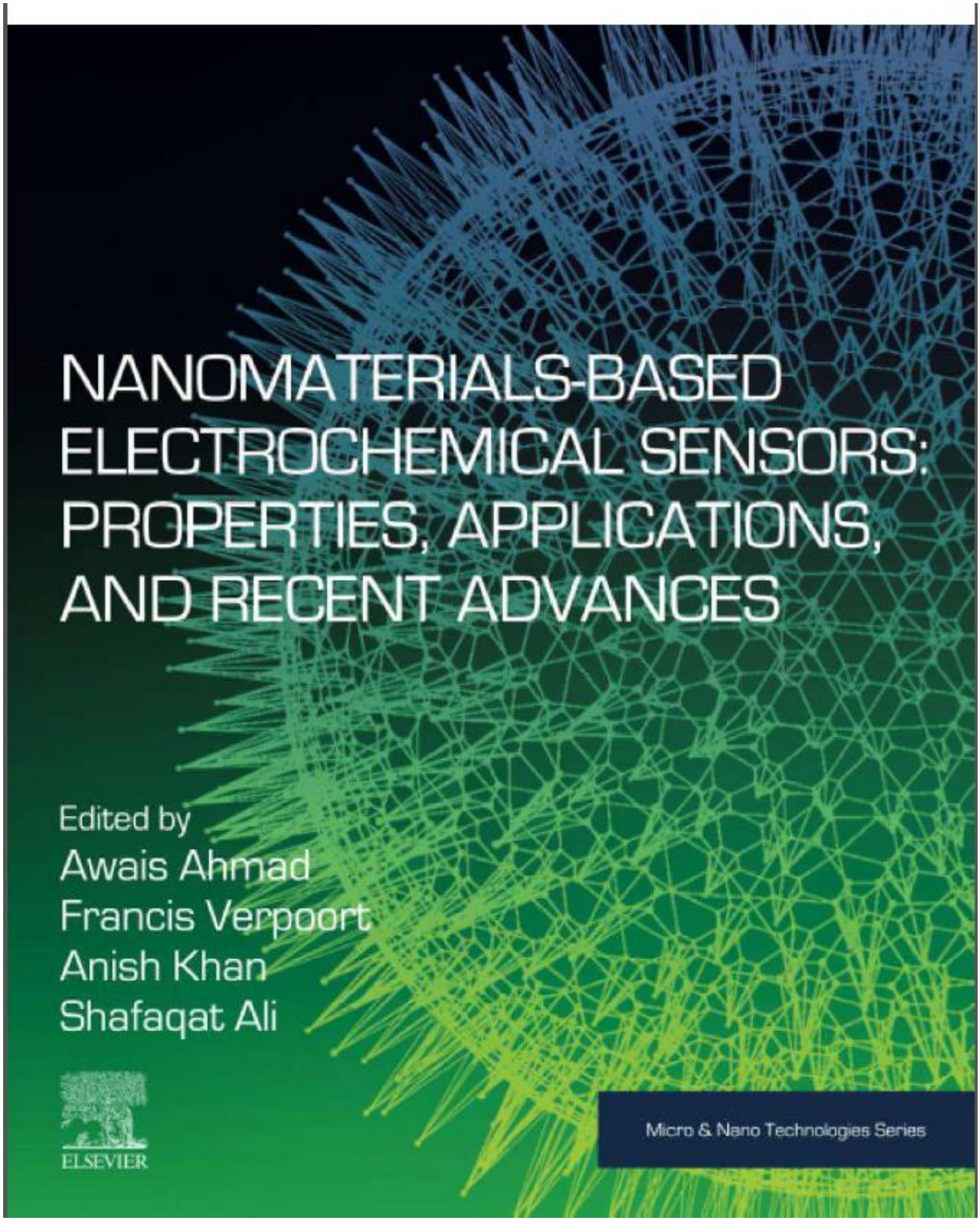
NANOMATERIALS-BASED ELECTROCHEMICAL SENSORS: PROPERTIES, APPLICATIONS, AND RECENT ADVANCES
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Toxicity of nanomaterials

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4.1 Introduction

4.1.1 Nanomaterials

Nanomaterials are the particles of organic or inorganic materials having defined sizes usually in the range of 1–100 nm. The source of nanomaterials may be natural, such as volcanoes and mineral springs, biogenic from living organisms [1], and man-made processes using plants [2,3] and microorganisms [4,5] and mining. Due to their light weight, smaller size, increased surface area, high conductivity, and high strength, they have gained wide application in areas such as optical, magnetic, electrical, pharmaceutical, environmental, medicine, energy production, mining, textile, automobiles, and so forth. These nanomaterials are inevitably released in the environment during the manufacturing process, use, and disposal process. Their unique properties and high penetration ability make them not only attractive for industrial and medical technologies, but also potentially harmful for the environment and living organisms. Several studies have revealed that upon entry into biological systems, the nanoparticles translocate and easily diffuse into the cell membrane and interact with the metabolic process in the cytoplasm, resulting in the generation of reactive oxygen species (ROS) [6]. The excess ROS production leads to oxidative stress that causes DNA damage, cytotoxicity, apoptosis, interruption in cell signaling, development of cancer, and other disorders [7,8]. Hence, there is a need to understand their toxicities and interaction with the biological system.

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