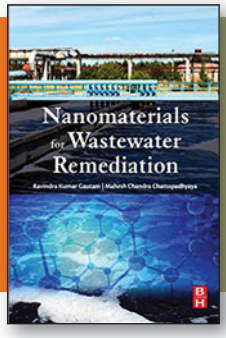
The book is divided into five sections. The first section introduces the reader to kinetics in materials science and engineering with an overview of its relationship to thermodynamics. The second section on reaction kinetics is divided into four chapters, with coverage of processes in materials, second order and multiple reactions, and temperature dependence of the reaction rate as applied to homogeneous and heterogeneous reactions. The next section covers phase transformations by discussing surface energies from considerations involving the existence of broken bonds in metals and polymers. This section contains extensive discussion on freezing point depression of small particles, interfacial energies, surface segregation, and surface tension.

The fourth section includes five chapters: (1) fundamentals of diffusion, (2) atomistics of diffusion, (3) steady-state diffusion, (4) solutions to Fick's second law, and (5) diffusion with finite boundaries. This section discusses the thermodynamics of phase transitions, reconstructive transformations, and nucleation and growth applied to homogeneous and heterogeneous cases, as well as diffusion phenomenon. The last section considers different types of fluxes, forces, and interdiffusion, with a treatment on nonideal thermodynamic behavior of solid and liquid solutions. The utility of the book is enhanced by a subject index and two appendices containing symbols.

The book provides every derivation and brings out the kinetic processes in materials science and engineering in an understandable way. As a teacher who has taught and is teaching courses in materials science and engineering and who has performed research in the area of electrochemical kinetics, I find this book extraordinary in all respects in giving in-depth mathematical derivations. However, the emphasis given on electrochemical kinetics applied to transient techniques using Fick's laws is minimal, except for dealing with ion conductance.

This is an excellent book, and although it should not be used as the primary text for a kinetics course (no mention of the fundamentals and applications of kinetics, such as pulse radiolysis; fluorescence; photolysis; temperature-jump, pressure jump, or stopped flow techniques; electron spin resonance; or nuclear magnetic resonance), I strongly recommend it as supplemental text for a general course introducing materials science and engineering at the graduate level.

Reviewer: K.S.V. Santhanam *is a professor in the School of Chemistry and Materials Science at Rochester Institute of Technology, USA.*



Nanomaterials for Wastewater Remediation

Ravindra Kumar Gautam and
Mahesh Chandra Chattopadhyaya

Butterworth-Heinemann, 2016
366 pages, $170.00 (e-book $170.00)
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This book is a comprehensive overview of the advances in water remediation processes via nanotechnology. It covers most of the nanomaterials that are presently being used, as well as nanomaterials that are still under investigation, such as magnetic nanoparticles, bimetallic nanoparticles, and carbon- and alumina-based structures. References are ample, as the book is written for all types of readers, not only those in the scientific community. For novices in water remediation, this book provides basic information on the field and is a good textbook for students; for experts, the book provides updates on state-of-the-art methods.

Chapter 1 introduces various nanomaterials that are promising agents for water remediation. It also emphasizes the lack of cost-effectiveness and risk assessment for the current nanomaterials and their by-products. Chapter 2 focuses on industrial pollutants and contemporary water remediation solutions, such as reverse osmosis, advanced oxidation techniques (further discussed in chapter 3), nanosorbtion (with an emphasis on graphene-based nanosorbents, further detailed in chapters 4–6), and magnetic nanomaterials. Chapter 3 addresses catalytic nanomaterials capable of generating highly reactive OH^- radicals via photochemical, sonochemical, electrochemical, and photo-Fenton oxidation processes.

Chapters 4–6 are dedicated to the growing field of graphene-based nanosorbents that are efficient in capturing heavy metals, such as Hg and Pb, along with organic dyes. Graphene or reduced graphene-based organic or inorganic composites and their efficiency on toxins and various organic and inorganic pollutants are reviewed and systematized. Chapter 5 reviews kinetic models of graphene-based sorbents. Also, Langmuir, Temkin, and Freundlich isotherms are discussed for various nanosorbents, and functionalized graphene is mentioned as being efficient in adsorbing particular heavy metals. Chapter 6 discusses magnetic nanoparticles combined with graphene-based nanocomposites and photocatalytic composites for sorption of dyes.

Chapter 7 makes the case for magnetic nanoparticles as efficient nanosorbents on their own, rather than being coupled with graphene. This chapter also discusses the stability of these nanomaterials in terms of the pH of the solution, as well as their synthesis and morphology. Magnetite and maghemite nanoparticles and their composites in the removal of arsenic are given particular attention. Chapter 8 describes the potential of layered double hydroxides possessing high anion exchange capacity in the removal of organic and inorganic

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anions. Their appeal also lies in the removal of nuclear wastes and rare-earth metals, along with toxic vapors from water. Chapter 9 further elaborates on magnetic nanoparticles and their photocatalytic properties in wastewater treatment. Most popular is the omnipresent TiO_2 combined with SiO_2. However, the materials capacity in oxidizing Cr and As, degrading oil and various phenols, and killing pathogenic bacteria must be considered.

Chapter 10 is dedicated to various alumina powder phases ranging from α to χ alumina. Synthesis, characterization, and applications in the removal of organic compounds (surfactant, phenols, etc.) and a few inorganic compounds are provided, even though the majority of the studies were laboratory-based. Chapter 11 focuses on bimetallic nanoparticles, such as Fe-Cu and Fe-Ni, and their role in dechlorinating water under neutral pH conditions. Chapter 12 reviews methods to reuse nanomaterials after desorption and regeneration, and Chapter 13 covers nanotoxicity and responsible nanotechnology usage.

Graphene-based nanomaterials, incorporating the ubiquitous TiO_2 nanoparticles, stand out in this book as a promising method of water remediation. However, the book also provides various drawbacks in the uses of these nanomaterials. For example, graphene-based materials require methods of production that are themselves polluting. Moreover, the regeneration and desorption of the nanomaterials for their reuse is a challenge, again, because these processes are polluting.

The figures are precise and adequate. Some chapters lack tabulated data. This book will appeal to a varied readership and is in line with the present-day scenario of clean water challenges.

Reviewer: Protima Rauwel *of Tallinn University of Technology, Estonia.*

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