Diamondoid molecules: with applications in biomedicine, materials science, nanotechnology and petroleum science


Diamondoids are a peculiar class of hydrocarbon, with unique structures and properties. They possess typical characteristics of diamond face-fused cages with hydrogen-terminated dangling bonds. Diamondoids and derivatives have been of great interest since their discovery, due to their important and diverse roles in biomedicine, materials science, petroleum science and, more recently, nanotechnology. Due to their six or more linking groups, they have found major applications as templates and as molecular building blocks in nanotechnology, polymer synthesis, drug design and delivery and DNA-directed assembly, just to name a few.

I was very impressed to learn from this book that diamondoid molecules have so many peculiar properties and possible applications. Diamondoids have very high melting points compared with other hydrocarbons and organic molecules. Diamondoids have negative electron affinities, are transparent to visible light and have high electrical insulating properties, as diamond does. They are one of the growing category of molecules being considered as molecular building blocks in the design of nano-electromechanical and micro-electromechanical systems in wet nanotechnology/ nanobiotechnology and in biomedicine.

Already diamondoids are used to design drugs against infectious diseases such as influenza and HIV, gram-positive bacteria and MTB (Mycobacterium tuberculosis) and parasitic infections such as malarial. In the fight against cancer, diamondoid derivatives are used in chemotherapy and anticancer drugs; they are also used as a neuroprotective agent for Alzheimer’s disease, in drugs with antioxidative effects and hypoglycemic action, and in diabetes treatments, drug delivery and drug targeting.

The book consists of seven chapters with many appropriately arranged and designed tables, figures and graphs. It also contains an excellent and lengthy glossary. Chapter 1 presents the molecular structure and chemistry of diamondoids. That includes the classification and crystalline structure of diamondoids, the distinction between well-defined diamondoids and nanodiamonds, which are, in principle, nanoparticles. The authors also present the synthesis and functionalization of lower diamondoid cages including adamantane, diamantane and triaminomethane.

In Chapter 2, the authors present detailed information about the existence, genesis and role of diamondoids in petroleum and other fossil fuels. This includes the use of diamondoids as geochemical tools for petroleum characterization and their role in petroleum and natural gas flow fouling. Also, methods for separation, detection and measurements of petroleum diamondoids are discussed.

The available data and correlations on physical properties of diamondoids, including their spectrometric, optical and thermodynamic properties are reported in Chapter 3.

Chapter 4 covers diamondoids as molecular building blocks for nanotechnology. This includes the futuristic mechanosynthesis based on diamondoids, applications of diamondoids as molecular components of nanosystems, and their use for host–guest chemistry and in inclusion compounds. Quantum calculation methods and results regarding prediction of the properties of diamondoids are reported in Chapter 5, including electronic, structural and intermolecular interaction properties of diamondoids and derivatives.

Chapter 6 highlights the diverse and growing biomedical applications of diamondoids. Hence, subjects such as drug design and delivery in fighting infectious diseases, cancer, hypoglycaemia and diabetes with diamondoid derivatives are discussed.

Applications of diamondoids in materials science at the macro and nano scales are discussed in Chapter 7. For macroscopic systems, this includes applications of diamondoids in polymer synthesis, in polymer nanocomposites and in crystal engineering. For nanosystems, the authors discuss applications of diamondoids in the design of diamondoid–DNA nanostructures and self-assembly of diamondoid molecules and derivatives towards NEMS and MEMS production.

This book includes all the features and important literature about diamondoid molecules that researchers in diamondoids would like to have on hand for further research. It is a highly informative book, which I recommend to all researchers of physics, chemistry, nanomedicine, nanotechnology and material science because of the increasing variety of applications of diamondoid molecules – this book gives the whole story about these molecules. This is because this book is highly specific to diamondoids, so would not be appropriate for general undergraduate or graduate physical sciences or engineering courses.