

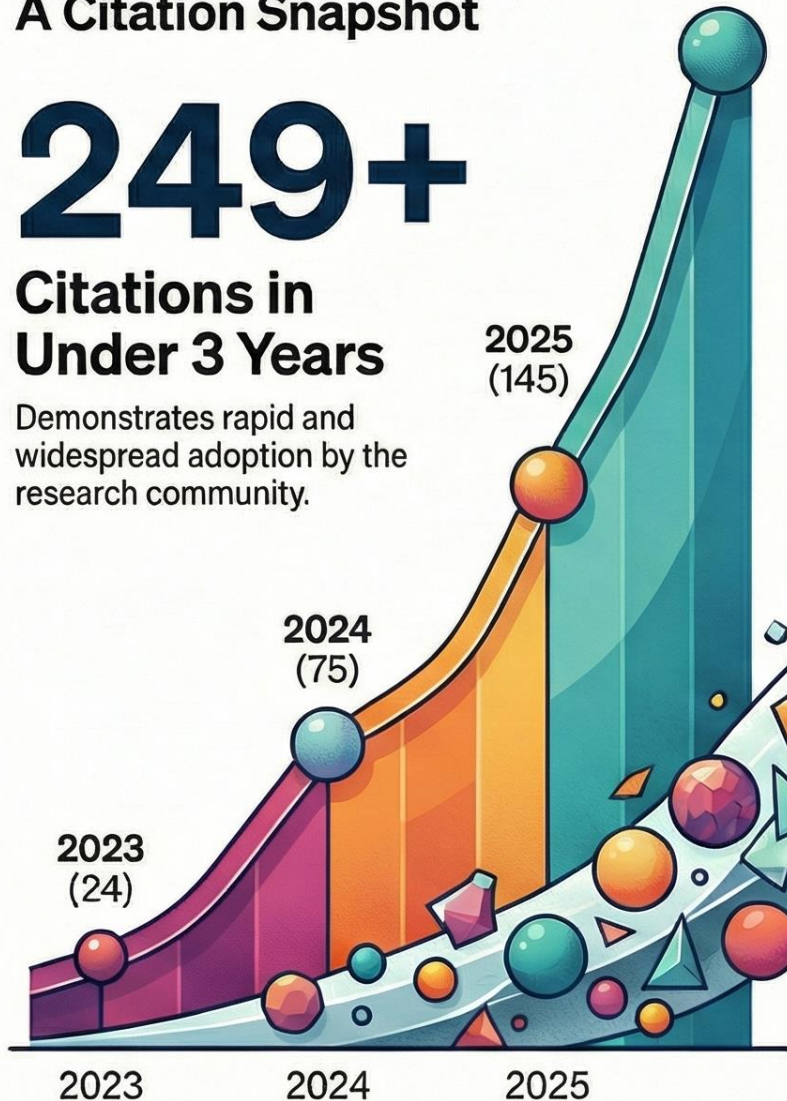
Shaping the Field: The Impact of a Foundational Review Article

Surging Influence: A Citation Snapshot

249+

**Citations in
Under 3 Years**

Demonstrates rapid and widespread adoption by the research community.



A Unifying Framework for a Scattered Field

Synthesizes previously dispersed literature,
filling a critical knowledge gap.

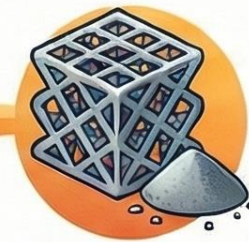
Shifts the Paradigm to “Shape as a Design Variable”

Challenges researchers to
consider geometry as critical as
material composition.

Broad Interdisciplinary Relevance



**Batteries &
Nanomaterials**
Standard reference
in materials science.



**3D Printing
& Powder
Metallurgy**
Crucial for advanced
manufacturing.



**Geomechanics
& Mineral
Processing**
Applied in resource
engineering.



**Polymer
Composites &
Ceramics**
Key for structural
applications.



Impact Statement: A Review of Particle Shape Effects on Material Properties for Various Engineering Applications: From Macro to Nanoscale

1. Introduction: Quantifiable Impact and Central Thesis

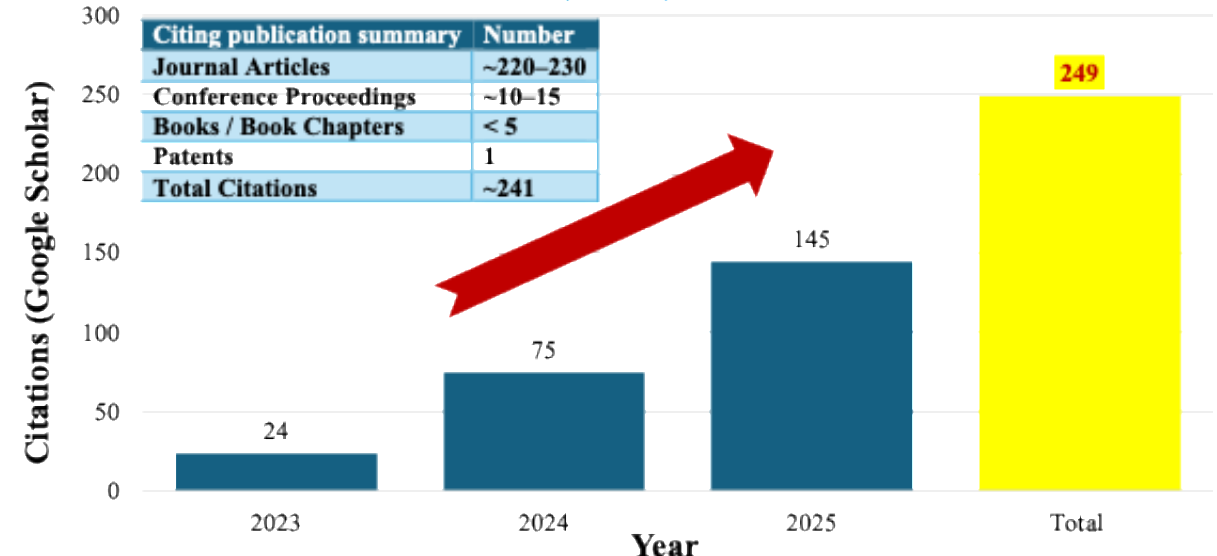
This review has rapidly established itself as a work of significant and growing influence within the scientific community. Since its publication, the article has demonstrated a remarkable uptake, evidenced by a strong and accelerating citation trend that not only underscores the relevance of its subject matter but also establishes the work as a central reference in its field.

The article's quantitative impact provides a clear measure of its influence and adoption. The citation record shows a consistent and steep increase year over year 🙌

This accelerating citation velocity is the hallmark of a future "citation classic"—a definitive work that is actively shaping the direction of its field.

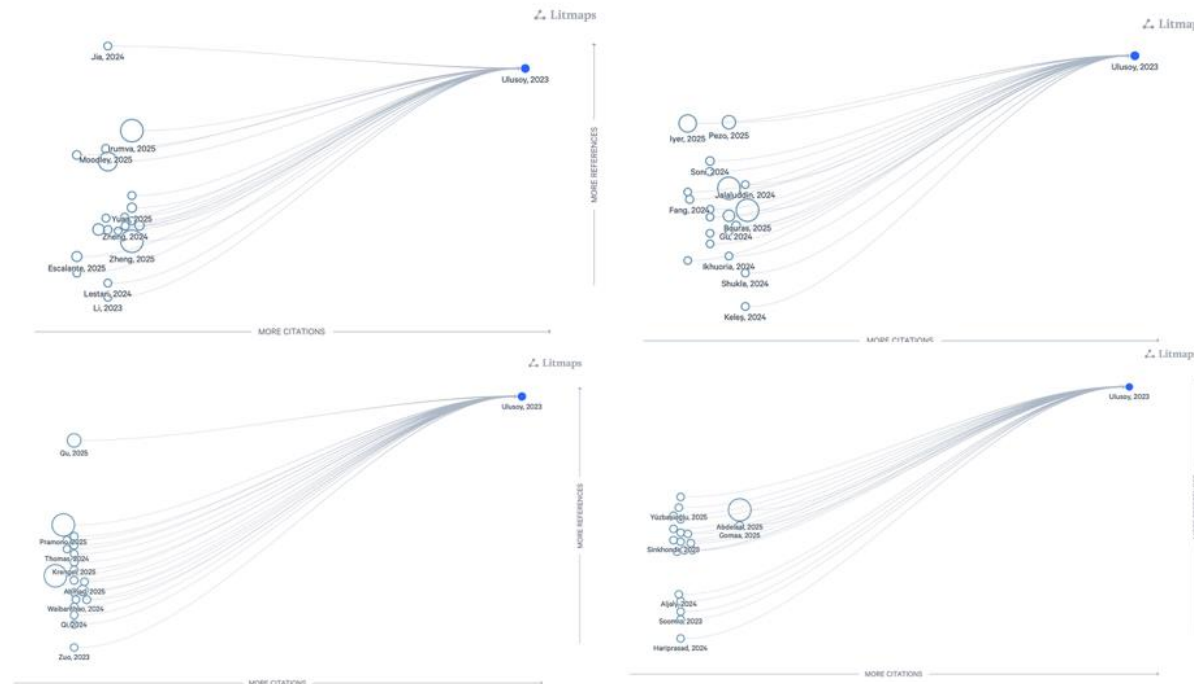
The following sections will explore the reasons behind this significant impact, beginning with the critical knowledge gap the article successfully addressed.

MY 2023 REVIEW PAPER "A review of particle shape effects on material properties for various engineering applications: From macro to nanoscale"



2. Filling a Critical Knowledge Gap

Seminal review articles derive their impact from synthesizing fragmented knowledge into a coherent and accessible framework. This review was strategically designed to fill such a void, addressing a pressing gap in the understanding of how particle shape influences material properties across scales. Prior to its publication, literature on particle morphology was scattered across numerous disciplines, leaving research teams without a single, comprehensive resource. The article provided a crucial contribution by systematically summarizing this disparate literature into a unified body of knowledge, presenting a new conceptual classification model that helped to define concepts, and establishing consistent terminology for the field. Critically, it also highlighted unresolved scientific questions, thereby creating a unified starting point that both grounds and inspires new experimental, modeling, and production-focused research. This foundational role is a primary driver of its broad adoption across a multitude of scientific and engineering domains.

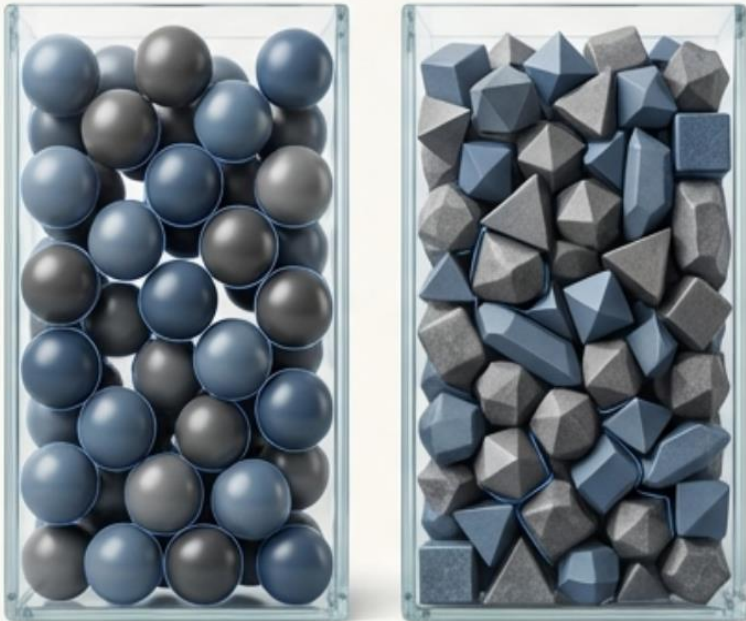


Property	Round Particles (e.g., sand)	Angular Particles (e.g., crushed stone)
Packing Density	Lower	Higher
Interlocking	Poor	Excellent
Final Strength	Good	Superior
Application	Flowable Fill	High-Strength Concrete, Asphalt

Shape Dictates Behavior.

The morphology of a particle directly influences bulk material properties. A simple change in geometry can radically alter how materials pack, flow, interact, and perform. This principle operates universally, from drug delivery systems to the structural integrity of concrete.

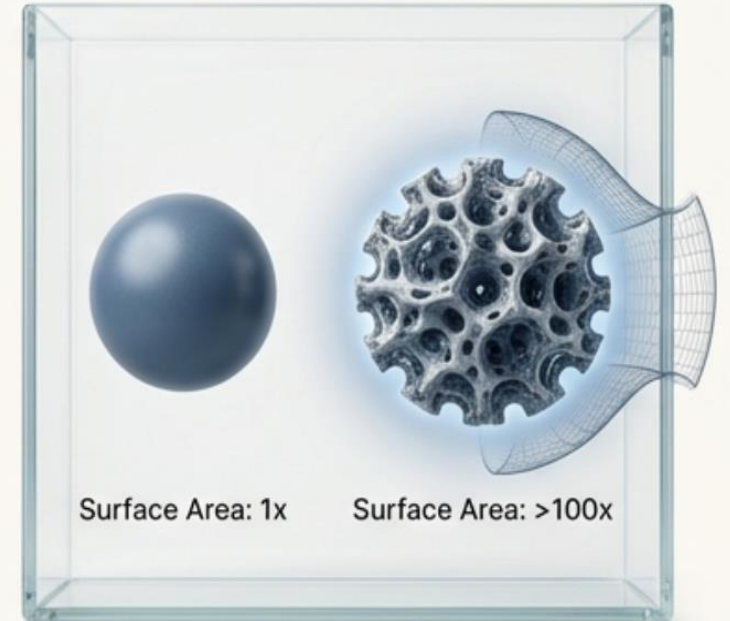
Packing & Density



Flow & Rheology



Surface Area & Reactivity





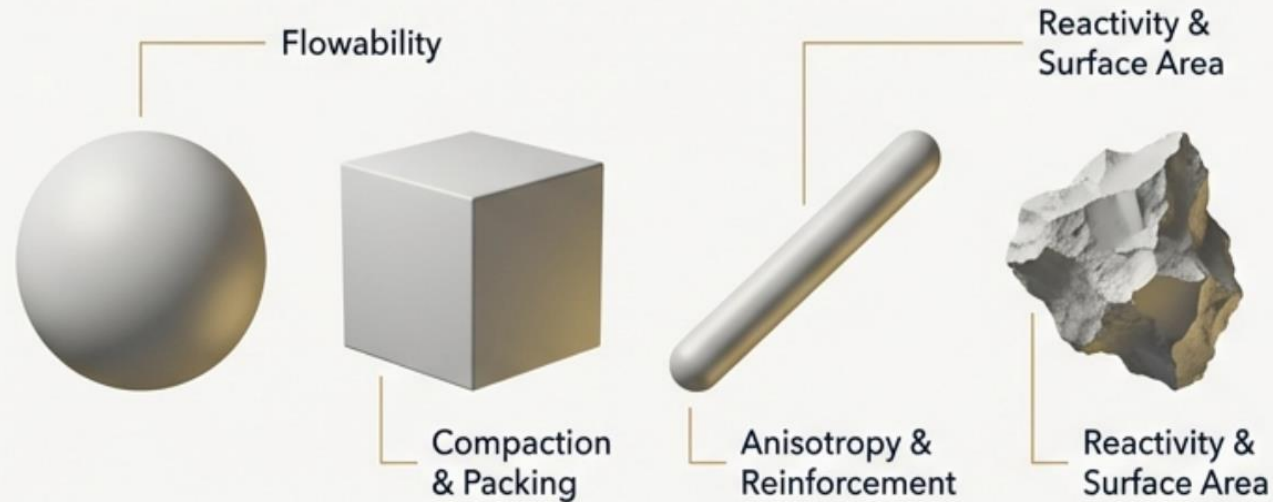
Particle Shape Effects

How a particle's form—roundness, angularity, complexity—influences the properties of a material.



The Premise: Why Particle Shape is a Fundamental Parameter in Science

In 2023, our review synthesized the critical role of particle shape on material properties. Moving beyond simple size metrics, the paper established a comprehensive framework demonstrating how morphology—from sphericity to angularity—dictates performance in countless engineering applications. It addressed a crucial knowledge gap, creating a unified resource for researchers across disparate fields.



REVIEW: THE UNIFYING ROLE OF PARTICLE MORPHOLOGY IN MATERIAL SCIENCE

ABSTRACT

This review examines the critical influence of particle shape on the physicochemical properties of materials across diverse fields. Synthesizing decades of research, we establish a unified framework connecting core morphological descriptors to engineering performance. By moving beyond traditional size-based analyses, this paper highlights how specific particle geometries—from high-sphericity granules to high-aspect-ratio rods and angular fragments—dictate key functionalities such as flow behavior, packing density, mechanical reinforcement, and surface reactivity. The synthesis provides a roadmap for tailoring material properties through precise morphological control, addressing a significant knowledge gap and fostering interdisciplinary collaboration.

The Ripple Effect: Tracing the Cross-Disciplinary Impact of a Foundational Review

An analysis of the influence stemming from the 2023 publication: “A review of particle shape effects on material properties for various engineering applications.”



A review of particle shape effects on material properties for various engineering applications.

An Ecosystem of Innovation



The 2023 review has served as a foundational text, catalyzing new research in diverse and emergent scientific domains. The following slides explore the impact within each of these key areas.

A Catalyst for High-Impact Publications

nature
publishing group



 **Springer**

 **ACS Publications**

WILEY

 **Taylor & Francis**
ENLIGHTENING DISCOURSE

 **MDPI**

IOPscience

 **APS**
physics

The review paper is consistently cited in leading, peer-reviewed journals, indicating its acceptance and integration into the highest levels of scientific discourse.

Quantifying the Influence: A Global Academic Footprint

100+

Citing Research Articles and
Conference Papers (Published
or in press for 2024-2026)



Continents Represented by
Citing Research Institutions

15+

High-Impact International
Publishers

The impact is demonstrated not only by the diversity of research fields but also by the volume and global distribution of the citing works.

The Enduring Importance of a Fundamental Principle

The extensive and varied citations demonstrate that the 2023 review, “A review of particle shape effects on material properties for various engineering applications,” has become more than a publication. It serves as a foundational resource and a catalyst for innovation. The study of particle shape is not a niche subfield; it is a fundamental pillar of modern science and engineering, with a future of expanding applications yet to be discovered.



3. Broad Interdisciplinary Relevance and Influence

A key indicator of truly foundational research is its ability to transcend disciplinary boundaries. The influence of this review article extends far beyond a single specialization, demonstrating its fundamental importance to a wide array of scientific and engineering fields. Its interdisciplinary significance is evident in its application across numerous domains:

Materials Science	Chemical Engineering	Tribology
Geomechanics & Civil Engineering	Nanotechnology	Powder Technology
Batteries	Mineral Processing	Ceramics
Powder Metallurgy	Polymer Composites	3D Printing Powders

The article's broad uptake is driven by its utility in empowering researchers to justify the treatment of particle shape as a primary variable controlling performance, rather than a secondary or incidental parameter. It has become a standard reference in fields as diverse as geomechanics, where it supports analyses of civil engineering materials; mineral processing, where it contextualizes studies on flotation efficiency and comminution product quality; and computational science, where it underpins DEM simulations requiring realistic particle geometries. This cross-disciplinary adoption confirms that the review addresses a universal challenge in materials engineering, a breadth of influence matched only by the depth of its conceptual contribution.

4. A Foundational Reference and a Paradigm Shift in Materials Design

The article's most significant contribution is its role in catalyzing a paradigm shift in materials design, elevating particle shape from a secondary characteristic to a fundamental design parameter on par with composition and processing conditions. This conceptual re-framing challenges the traditional focus on chemistry and manufacturing alone, arguing compellingly that geometry is an equally critical parameter for tailoring material properties. This shift is reflected in how the research community now utilizes the article as a foundational framework. **It serves as:**

- A fundamental framework for understanding the complex relationship between particle shape and material properties.
- A starting point for developing new methods, terminology, and categorization schemes for morphological descriptors.
- A summary reference used to justify and contextualize new research, providing a robust foundation upon which new studies are built.

By foregrounding particle morphology as a central, tunable parameter, this review has opened new and promising avenues for innovation in materials engineering.

Engineering Process

1. Characterize

Analyze the exact shape of particles using advanced imaging and AI.

2. Control

Refine synthesis methods to create particles with the desired shape.

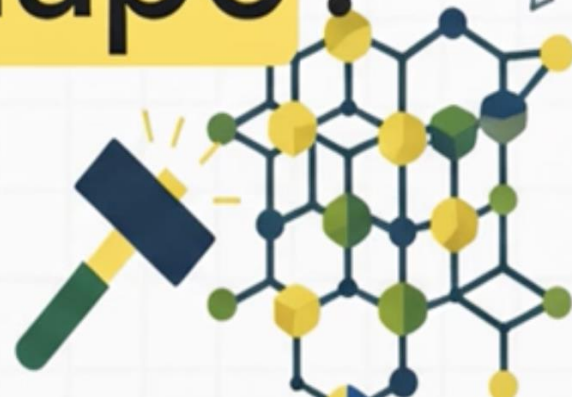
3. Engineer

Apply custom-shaped particles to a final product to solve a problem.





What global challenge
can be solved by
changing a shape?



✓ 7.139 Energy & Fuels	17	✓ 2.89 Ionic, Molecular & Complex Liquids	2	✓ 3.180 Microbial Biotechnology	1
✓ 7.229 Mineral & Metal Processing	17	✓ 3.60 Herbicides, Pesticides & Ground Poisoning	2	✓ 3.45 Soil Science	1
✓ 7.109 Ceramics	9	✓ 3.83 Bioengineering	2	✓ 3.87 Paper & Wood Materials Science	1
✓ 7.133 Geotechnical Engineering	9	✓ 3.85 Food Science & Technology	2	✓ 3.91 Contamination & Phytoremediation	1
✓ 2.165 Nanofibers, Scaffolds & Fabrication	7	✓ 4.17 Computer Vision & Graphics	2	✓ 4.58 Wireless Technology	1
✓ 2.67 Nanoparticles	6	✓ 5.77 Applied Physics	2	✓ 5.200 Nuclear Fusion	1
✓ 7.121 Concrete Science	6	✓ 8.140 Water Resources	2	✓ 5.56 Quantum Mechanics	1
✓ 2.90 Water Treatment	5	✓ 1.172 Sports Science	1	✓ 5.98 Geometrical Optics	1
✓ 7.12 Metallurgical Engineering	5	✓ 1.217 Parasitology - Malaria, Toxoplasmosis & Coccidiosis	1	✓ 6.27 Political Science	1
✓ 2.39 Polymer Science	3	✓ 1.257 Birth Defects	1	✓ 7.215 Friction & Vibration	1
✓ 2.53 Polymers & Macromolecules	3	✓ 1.323 Legionellosis	1	✓ 7.226 Electrical - Sensors & Monitoring	1
✓ 6.115 Sustainability Science	3	✓ 2.145 Biosensors	1	✓ 7.227 Manufacturing	1
✓ 2.160 Microfluidic Devices & Superhydrophobicity	2	✓ 2.210 Corrosion & Deposition Chemistry	1	✓ 7.300 Asphalt	1
✓ 2.176 Drug Delivery Chemistry	2	✓ 2.41 Catalysts	1	✓ 7.57 Modelling & Simulation	1
✓ 2.59 Pigments, Sensors & Probes	2	✓ 2.76 2d Materials	1	✓ 7.63 Mechanics	1
				✓ 7.70 Thermodynamics	1

✓ 7.229.1157 Flotation	16	✓ 2.160.365 Superhydrophobic	1	✓ 3.87.269 Cellulose Composites	1
✓ 7.139.524 Fluidization	12	✓ 2.165.679 Additive Manufacturing	1	✓ 3.91.920 Selenium	1
✓ 7.121.26 Advanced Concrete	6	✓ 2.176.140 Oral Delivery	1	✓ 4.58.1125 Microwave Absorption	1
✓ 7.133.114 Soil-structure Interaction	6	✓ 2.176.878 Cocrystals	1	✓ 5.200.1596 Positronium	1
✓ 2.67.231 Nanotoxicology	5	✓ 2.210.137 Corrosion Inhibition	1	✓ 5.56.1685 Casimir Effects	1
✓ 2.90.27 Adsorption	3	✓ 2.39.511 Polymer Rheology	1	✓ 5.98.640 Fringe Projection	1
✓ 7.109.1491 Ceramic Waste Utilization	3	✓ 2.39.540 Flame Retardant Polymers	1	✓ 6.115.1244 Municipal Solid Waste	1
✓ 2.165.1082 Calcium Carbonate Crystallization	2	✓ 2.39.806 Polyurethane Innovations	1	✓ 6.27.1948 Geoengineering Policy	1
✓ 2.165.163 Hydroxyapatite Composites	2	✓ 2.41.148 Mesoporous Silica	1	✓ 7.109.1110 Laser Cladding	1
✓ 2.165.844 Electrospinning	2	✓ 2.53.1268 Polymer Coatings	1	✓ 7.109.589 Ceramic Sintering	1
✓ 2.53.2046 Pickering Emulsions	2	✓ 2.59.1261 Peptide Self-assembly	1	✓ 7.12.608 Magnesium Alloys	1
✓ 2.89.72 Vapor-liquid Equilibria	2	✓ 2.59.250 Cyclodextrins	1	✓ 7.133.2406 Electrokinetic Remediation	1
✓ 3.85.741 Chitosan Packaging Films	2	✓ 2.62.1768 Dealloying	1	✓ 7.139.1755 Cyclone Separators	1
✓ 4.17.2798 Stereo Depth Estimation	2	✓ 2.62.52 Electrode Materials	1	✓ 7.139.1964 Spontaneous Combustion	1
✓ 5.77.196 Multiferroics	2	✓ 2.67.370 Magnetic Nanoparticles	1	✓ 7.139.89 Gasification	1
✓ 6.115.1554 Circular Economy	2	✓ 2.74.1306 Electrochromism	1	✓ 7.215.984 Bearing Dynamics	1

Publishers



Publishers

✓ Elsevier	62	✓ Amer Inst Mathematical Sciences-Aims	1	✓ Oficyna Wydawnicza Politechniki Wroclawskiej	1
✓ Mdpi	26	✓ Annual Reviews	1	✓ SPRINGER INT PUBL AG	1
✓ Springer Nature	23	✓ Edp Sciences S A	1	✓ Sage	1
✓ Wiley	7	✓ Int Information & Engineering Technology Assoc	1	✓ Univ Agriculture, Fac Veterinary Science	1
✓ Taylor & Francis	6	✓ Int Union Crystallography	1	✓ Univ Vasile Alecsandri Bacau	1
✓ Amer Chemical Soc	5	✓ Iop Publishing Ltd	1	✓ Univ Zagreb, Fac Mining, Geology & Petroleum Engineering	1
✓ Royal Soc Chemistry	5	✓ Keai Publishing Ltd	1	✓ Walter De Gruyter	1
✓ Amer Physical Soc	4	✓ Lippincott Williams & Wilkins	1	✓ World Scientific	1
✓ NATURE PORTFOLIO	3	✓ Lublin Univ Technology, Poland	1		
✓ AIP Publishing	2	✓ Malaysian Tribology Soc-Mytribos	1		
✓ Tech Science Press	2				

Research Areas

✓ Engineering	54	✓ Mechanics	6	✓ Cell Biology	1
✓ Materials Science	46	✓ Geology	5	✓ Crystallography	1
✓ Chemistry	34	✓ Mathematics	4	✓ Health Care Sciences Services	1
✓ Physics	22	✓ Agriculture	3	✓ Immunology	1
✓ Mining Mineral Processing	19	✓ Biochemistry Molecular Biology	3	✓ Meteorology Atmospheric Sciences	1
✓ Mineralogy	17	✓ Public Environmental Occupational Health	3	✓ Nuclear Science Technology	1
✓ Metallurgy Metallurgical Engineering	11	✓ Biotechnology Applied Microbiology	2	✓ Nutrition Dietetics	1
✓ Science Technology Other Topics	11	✓ Computer Science	2	✓ Optics	1
✓ Construction Building Technology	8	✓ Food Science Technology	2	✓ Pharmacology Pharmacy	1
✓ Energy Fuels	8	✓ Instruments Instrumentation	2	✓ Spectroscopy	1
✓ Geochemistry Geophysics	8	✓ Toxicology	2	✓ Surgery	1
✓ Polymer Science	8	✓ Veterinary Sciences	2	✓ Thermodynamics	1
✓ Environmental Sciences Ecology	7	✓ Astronomy Astrophysics	1	✓ Water Resources	1

Sustainable Development Goals

✓ 06 Clean Water And Sanitation	24	✓ 13 Climate Action	9	✓ 02 Zero Hunger	2
✓ 03 Good Health And Well Being	22	✓ 07 Affordable And Clean Energy	7	✓ 14 Life Below Water	2
✓ 12 Responsible Consumption And Production	16	✓ 09 Industry Innovation And Infrastructure	4	✓ 15 Life On Land	1
✓ 11 Sustainable Cities And Communities	15				

Countries/Regions

✓ PEOPLES R CHINA	41	✓ THAILAND	5	✓ ALGERIA	1
✓ INDIA	21	✓ CANADA	4	✓ DENMARK	1
✓ IRAN	12	✓ IRAQ	3	✓ ETHIOPIA	1
✓ AUSTRALIA	11	✓ JAPAN	3	✓ FINLAND	1
✓ USA	11	✓ ROMANIA	3	✓ GREECE	1
✓ TURKIYE	10	✓ SOUTH KOREA	3	✓ ISRAEL	1
✓ ENGLAND	9	✓ BANGLADESH	2	✓ JORDAN	1
✓ GERMANY	8	✓ BELGIUM	2	✓ LIBERIA	1
✓ SAUDI ARABIA	8	✓ CHILE	2	✓ MOROCCO	1
✓ EGYPT	7	✓ CZECH REPUBLIC	2	✓ NORTH IRELAND	1
✓ FRANCE	7	✓ ITALY	2	✓ PERU	1
✓ MALAYSIA	7	✓ KENYA	2	✓ RWANDA	1
✓ NIGERIA	7	✓ PAKISTAN	2	✓ SCOTLAND	1
✓ BRAZIL	6	✓ SERBIA	2	✓ SWEDEN	1
✓ RUSSIA	6	✓ SPAIN	2	✓ U ARAB EMIRATES	1
✓ INDONESIA	5	✓ SWITZERLAND	2	✓ WALES	1

5. Future Research Trajectories and Implications for Innovation

The value of a seminal review lies not only in its summary of past work but also in its capacity to chart a definitive course for future discovery. This article provides a forward-looking agenda that is already inspiring and guiding subsequent studies across both academic and industrial research communities. The insights delineated in the review are poised to accelerate progress in several key areas:

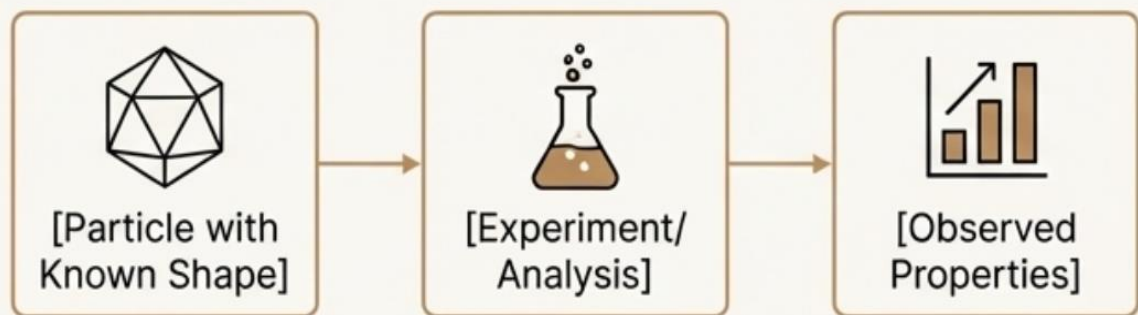
1. **Innovation in Functional Materials** By providing a clear framework for understanding shape-dependent effects, the review can accelerate the development of multifunctional materials—those that combine mechanical robustness with advanced electrical, thermal, or biological functionalities.
2. **Contribution to Sustainable Engineering** The work highlights how optimizing particle shape can lead to more efficient and sustainable solutions, including reduced material usage, enhanced recyclability, and improved performance, aligning directly with global sustainability goals.
3. **Advancements Across Applied Fields** The principles outlined are expected to inspire significant developments in a range of applied fields, including nanocomposites, advanced manufacturing, catalysis, energy systems, civil engineering, and biomedical applications.

This forward-looking agenda fulfills the author's stated hope that the review will continue to "provide new conceptual syntheses, define terminology adopted by others, and guide future experimental or computational studies," thereby serving as a catalyst for the next generation of materials innovation.

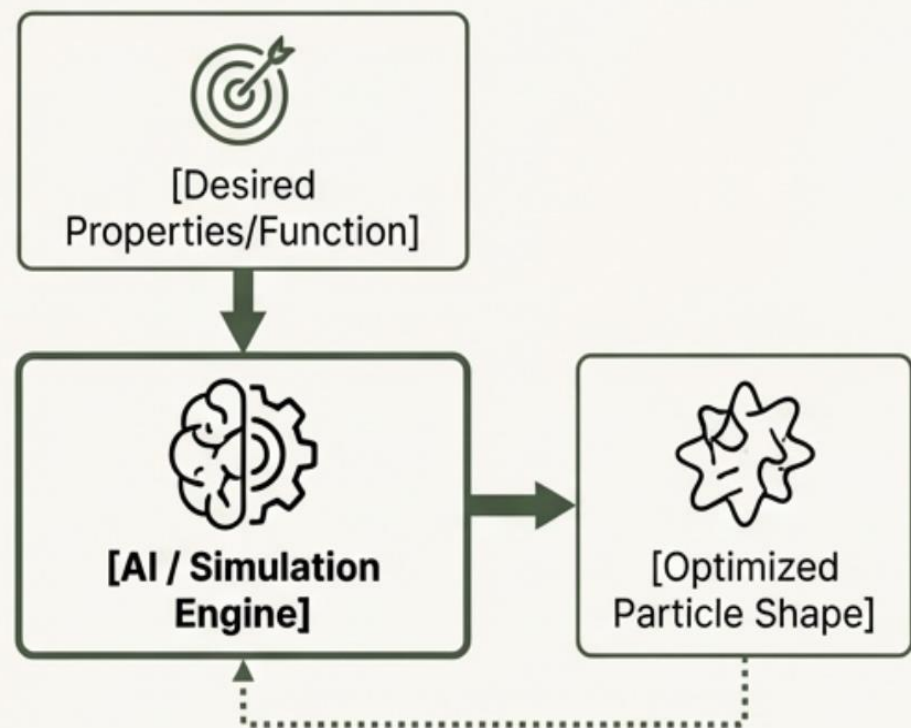
• By mastering the shape of the **infinitely** small, we are learning to solve our **largest** challenges.

The Paradigm Shift: From Observation to Inverse Design

The Past: Observation



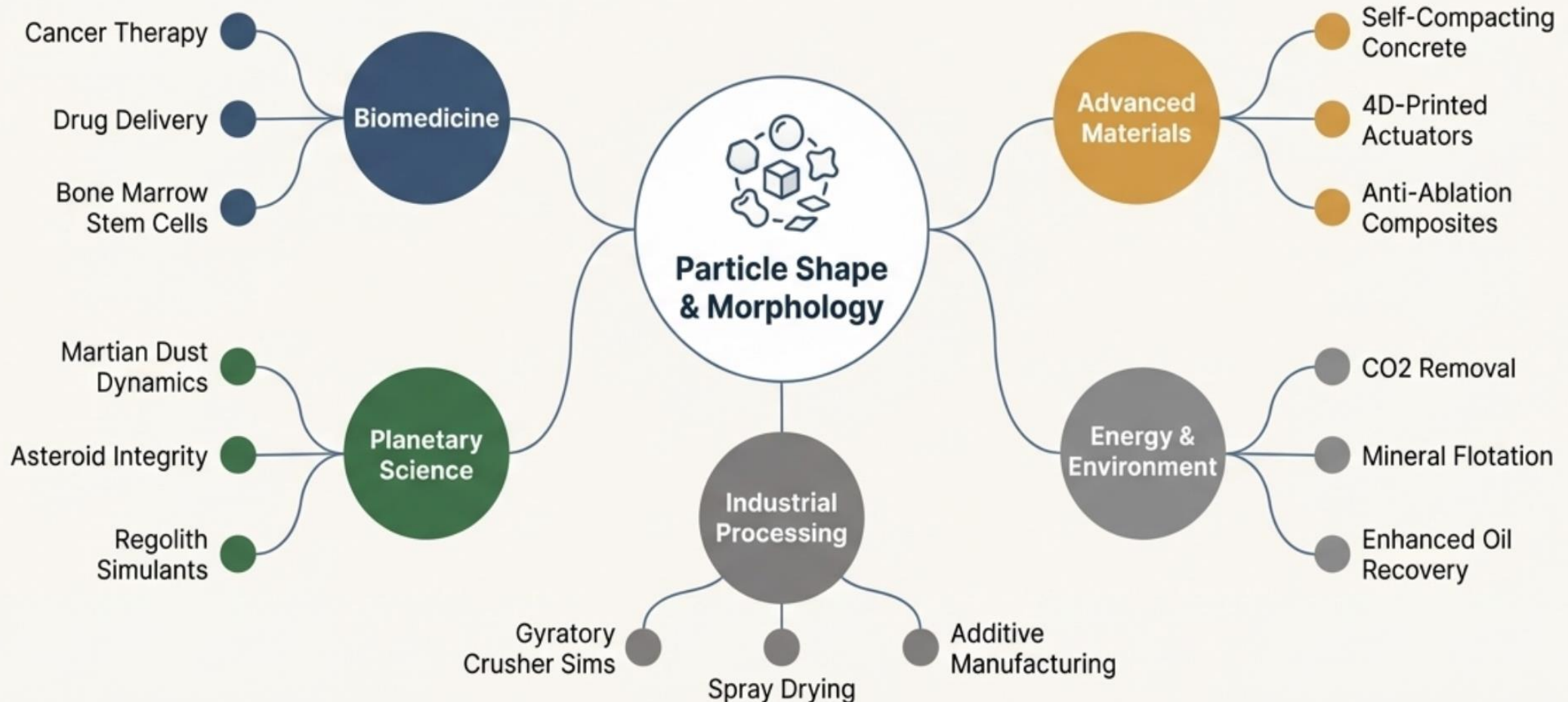
The Future: Inverse Design



Leveraging computational tools like Deep Learning, we no longer just ask 'What does this particle do?' We now ask, "What particle do we need to achieve our goal?"

A Cross-Disciplinary Language.

The principles of particle shape provide a common framework for innovation, connecting fields that were once siloed. Understanding granular mechanics in one domain can unlock breakthroughs in another.





6. Conclusion: A Unifying and Enduring Contribution

The 2023 review article on particle shape effects has rapidly established itself as a landmark publication in materials science and engineering. Its impact is demonstrated by its high and accelerating citation rate, which points to its increasing centrality within the research community.

By filling a critical knowledge gap, it has become a foundational and unifying reference with **strong interdisciplinary** relevance, consulted by researchers across dozens of engineering and scientific domains. Most importantly, the work has catalyzed a paradigm shift, elevating particle morphology from a peripheral concern to a central parameter in modern materials design. This review not only synthesizes existing knowledge with authority but also establishes a definitive roadmap for future innovation, cementing its role in shaping the future of materials engineering for years to come.



If we can design the
smallest things, what
giant problems will we
solve next?