

Metamaterials Market Size, Share, Trends and Forecast by Type, Application, End User, and Region, 2025-2033

Market Report | 2025-09-01 | 135 pages | IMARC Group

AVAILABLE LICENSES:

- Electronic (PDF) Single User \$3999.00
- Five User Licence \$4999.00
- Enterprisewide License \$5999.00

Report description:

The global metamaterials market size was valued at USD 1.0 Billion in 2024. Looking forward, IMARC Group estimates the market to reach USD 6.9 Billion by 2033, exhibiting a CAGR of 23.31% from 2025-2033. North America currently dominates the market, holding a market share of over 42.2% in 2024. The market is primarily driven by technological advancements in nanotechnology and photonics, increasing demand in wireless communication and defense sectors, expanding applications in healthcare and sustainable solutions, educational and research initiatives, and customization potential across various industries.

The metamaterials market is expanding due to increasing demand in telecommunications, aerospace, and defense. Their increasing ability to manipulate electromagnetic waves is driving advancements in technologies like 5G, radar, and stealth systems. On September 9, 2024, University of Glasgow engineers unveiled a 0.64mm-thick 2D metamaterial that converts linear to circular polarization, enhancing satellite communication and data reliability across Ku-, K-, and Ka-bands. Rising investments in research and development (R&D), supported by government and private funding, fuel continuous innovation. Additionally, their growing adoption in medical imaging, wearable devices, and renewable energy projects highlights their versatility. Moreover, lightweight, high-performance metamaterials are addressing complex technological challenges, solidifying their importance across diverse industries.

The United States is a key regional market and is expanding due to advancements in telecommunications, aerospace, and healthcare sectors. Demand for high-performance materials in 5G infrastructure, radar, and stealth technology drives growth, alongside rising investments in satellite communication. Metamaterials' applications in medical imaging, such as MRI enhancements, further augment healthcare innovation. On November 20, 2024, MIT researchers advanced ultrasound wave control in microscale acoustic metamaterials, enabling devices like acoustic demultiplexers for medical and communication uses. Their framework links geometry to material properties, improving fabrication methods. Additionally, metamaterials play a growing role in renewable energy solutions, enhancing solar panel efficiency and energy harvesting. These developments, supported by government and industry collaboration, solidify the United States' leadership in metamaterial innovation.

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

Metamaterials Market Trends:

Advancements in technology and materials science

Emerging innovations in nanotechnology and photonics can create matter with high levels of customization for electromagnetic, acoustic, and thermal properties. Such developments have opened new routes for its applications in telecommunication, healthcare, aerospace, and defense industries. In the telecommunication sector, they are used to generate much compact and efficient antennas operating at frequency ranges that are inevitable for 5G technologies. Ericsson Consumer Lab Global Survey reported that around 31 million smartphone users in India were expected to upgrade to 5G by the end of 2023, which would increase the demand for high-performance metamaterials necessary for optimizing 5G infrastructure. In healthcare, they are being explored for use in advanced imaging systems and sensor technologies. Moreover, ongoing R&D efforts are continuously expanding the capabilities and applications, further propelling market growth.

Increasing demand for wireless communication technologies

As the world becomes more interconnected with the proliferation of smartphones, (Internet of Things) IoT devices, and the advent of 5G networks, there is a growing need for advanced materials that can support these technologies. They play a critical role in this context by enabling the development of high-performance, miniaturized antennas and components that are essential for efficient signal transmission and reception in wireless communication systems. According to research, wireless communication systems, projected to handle 5016 EB/month global traffic by 2030, are critical for changing demands. Beyond 5G, with intelligent slicing and convergence capabilities, enables adaptable, efficient networks. Integrating Wi-Fi and 5G advances smart cities and metamaterial innovation, enhancing spectral efficiency and device connectivity. Their unique properties allow for better manipulation and control of electromagnetic waves, leading to enhanced performance and bandwidth in communication devices. This demand is propelling the market and encouraging investments in research and development to further harness these materials for telecommunications applications.

Rising interest in defense and security applications

They are increasingly being recognized for their potential in defense and security applications, which is a significant factor driving the market growth. For instance, global military spending increased to USD 2443 Billion in 2023, driven by heightened tensions, this increase fosters advancements in metamaterials for cutting-edge defense applications. Their ability to manipulate electromagnetic waves can be applied to create advanced radar and cloaking technologies, making them valuable for stealth operations. They can render objects less detectable to radar, a capability highly sought after in military applications. Additionally, the development hyperbolic metamaterials (HMMs) have implications for thermal imaging and infrared sensors, which are crucial in surveillance and night-vision technologies. Governments and defense agencies are investing in this area, seeking to leverage the strategic advantages offered by these advanced materials.

Metamaterials Industry Segmentation:

IMARC Group provides an analysis of the key trends in each segment of the global metamaterials market, along with forecast at the global, regional, and country levels from 2025-2033. The market has been categorized based on type, application, and end user.

Analysis by Type:

- Electromagnetic
- Terahertz
- Photonic

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- Tunable
- Frequency Selective Surface
- Others

Electromagnetic stand as the largest component in 2024, holding around 36.4% of the market. Electromagnetic materials are engineered to manipulate and control electromagnetic waves in unique ways. These materials are designed to interact with a range of electromagnetic waves, including microwaves, radio waves, and light. Their applications are diverse, encompassing areas such as advanced optical lenses, cloaking devices, and improved wireless communication systems. The ability of electromagnetic varieties to bend, shape, and focus electromagnetic waves beyond the capabilities of traditional materials makes them invaluable in sectors, such as defense, telecommunications, and medical imaging.

Analysis by Application:

- Antenna and Radar
- Cloaking Devices
- Super Lens
- Others

Antenna and radar lead the market with around 43.9% of market share in 2024. These materials in antenna and radar applications have revolutionized these technologies. They enable the creation of antennas that are more compact, efficient, and capable of operating over broader frequency ranges, which is crucial in today's wireless communication landscape. In radar systems, they enhance signal detection and imaging capabilities, offering improved resolution and range. These advancements are vital in sectors such as telecommunications, defense, and aerospace, where the demand for sophisticated communication and surveillance systems is continuously growing.

Analysis by End User:

- Aerospace and Defense
- Medical
- Automotive
- Consumer Electronics
- Energy and Power
- Others

Aerospace and defense lead the market with around 29.7% of market share in 2024. The use of meta-materials in aerospace and defense is pivotal. In these industries, these materials enhance the capabilities of communication systems, radar, and stealth technology. Their unique properties enable the development of advanced antennas and radar systems with improved performance, reduced size, and increased frequency bandwidth. They are also crucial in stealth technology, aiding in the development of materials that can effectively reduce the radar cross-section of aircraft and missiles. This application is key for modern defense strategies that rely on minimally detectable technology.

Regional Analysis:

- North America
 - o□ United States
 - o□ Canada
- Asia-Pacific
 - o□ China
 - o□ Japan
 - o□ India

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- o South Korea
- o Australia
- o Indonesia
- o Others
- Europe
- o Germany
- o France
- o United Kingdom
- o Italy
- o Spain
- o Russia
- o Others
- Latin America
- o Brazil
- o Mexico
- o Others
- Middle East and Africa

In 2024, North America accounted for the largest market share of over 42.2%. North America demonstrates strong growth due to its advanced technological infrastructure, significant investments in research and development (R&D), and the presence of key players in industries, such as defense, aerospace, and telecommunications. The United States leads in the adoption and development of technologies, particularly for defense applications and wireless communication advancements. This region's focus on innovation, coupled with substantial government and private sector funding, drives the market forward, fostering new applications and commercialization opportunities.

Key Regional Takeaways:

United States Metamaterials Market Analysis

In 2024, the United States represented 88.98% of the North America metamaterials market. The United States is experiencing a rise in demand for metamaterials, driven by advanced defense applications and increasing investments in aerospace innovations. For instance, in 2023, U.S. defense spending rose by USD 55 Billion, accounting for nearly 40% of global military expenditures, enhancing opportunities for metamaterials, as rising defense investments foster advanced technologies and innovations. Metamaterials' ability to enhance stealth and radar evasion capabilities makes them vital in next-generation military aircraft and drones. The telecommunications industry benefits significantly, with metamaterials enabling high-performance antennas and 5G signal optimization. Additionally, the renewable energy sector is leveraging metamaterials for more efficient solar panels and wireless power transmission, aligning with the country's push towards sustainability. The automotive sector is integrating metamaterials to develop lightweight yet strong materials for fuel-efficient vehicles. Healthcare applications, such as non-invasive imaging and targeted drug delivery, are gaining traction with continuous R&D support. Robust public and private funding in nanotechnology and material science fuels innovation, fostering rapid commercialization of metamaterial-based products.

Europe Metamaterials Market Analysis

Europe is witnessing significant advancements in metamaterials, driven by the demand for eco-friendly technologies and stringent regulations for energy efficiency. The aerospace sector capitalizes on metamaterials for noise reduction and advanced aerodynamics. The healthcare sector extensively adopts metamaterials for precise medical imaging techniques and wearable health monitoring devices. According to EU, the growing healthcare sector in the EU, with countries like Germany, France, and

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

Austria leading in healthcare expenditure relative to GDP (12.6%, 11.9%, and 11.2% respectively in 2022), presents significant opportunities for metamaterials. The rapid expansion in healthcare spending, particularly in Latvia, Romania, and other Eastern European nations, enhances demand for advanced technologies, including metamaterials for medical applications. This growth is fostering innovation and creating new avenues for metamaterials to improve healthcare outcomes. In addition, metamaterials find applications in creating sustainable construction materials, catering to Europe's green building initiatives. The focus on smart cities and urban planning integrates metamaterials in sensor technologies for enhanced infrastructure monitoring. European collaborations among research institutes and multinational corporations foster cutting-edge developments in photonic and acoustic metamaterials.

Asia Pacific Metamaterials Market Analysis

In the Asia-Pacific region, metamaterials are gaining prominence due to rapid industrialization and a booming consumer electronics market. The region's strong semiconductor manufacturing base is integrating metamaterials to create next-generation chips and components with improved performance. According to reports, China is set to become the world's leading semiconductor superpower, driving 60% of the industry's USD 1 Trillion growth by 2030. This increase in semiconductor manufacturing will significantly benefit the development of metamaterials, crucial for advancing IoT and smart environments. The push for high-speed internet has led telecommunications companies to adopt metamaterials for 5G infrastructure. Additionally, the automotive industry is incorporating metamaterials to design advanced safety systems and electric vehicles, aligning with sustainability goals. Research institutions and partnerships between academia and industry are accelerating innovation in optical metamaterials, crucial for virtual and augmented reality devices. Increasing government support and initiatives in emerging economies promote the adoption of metamaterials across diverse applications.

Latin America Metamaterials Market Analysis

In Latin America, the growth of metamaterials is primarily fueled by their use in renewable energy projects and agricultural innovations. Solar energy systems incorporate metamaterials to improve light absorption, increasing efficiency in power generation. For instance, Brazil leads the G20 in renewable electricity, with 89% of its power coming from renewables in 2023, three times the global average. Solar generation grew by 72% in 2023, contributing 7.3% to Brazil's electricity, benefiting metamaterials industries by driving cleaner, more sustainable energy solutions and reducing emissions. In agriculture, metamaterials are used for precision irrigation technologies, optimizing water usage and crop yields. Public-private partnerships focus on adapting metamaterials for cost-effective industrial solutions. Emerging sectors such as wearable technology and telecommunications also contribute to the rising demand for metamaterials.

Middle East and Africa Metamaterials Market Analysis

In the Middle East and Africa, the metamaterials market is driven by the increasing demand for advanced technologies in telecommunications and defense. With a focus on enhancing network capabilities and embracing next-generation wireless technologies like 5G, metamaterials are being explored for their potential to improve signal processing and antenna performance. In addition, the region's growing emphasis on smart city development and infrastructure modernization created opportunities for the use of metamaterials in sensors, imaging systems, and radar technologies. For instance, The UAE's impressive rise in the IMD Smart City Index 2024, with Abu Dhabi securing 10th and Dubai 12th positions, highlights the rapid growth of smart cities. This development fosters an ideal environment for metamaterials, offering opportunities for advanced technologies that enhance infrastructure, communication, and sustainability. The aerospace sector is also a key player, with metamaterials helping to reduce weight and improve performance in aircraft and other high-tech applications. Furthermore, regional investments in innovation and technological development are fueling the adoption of metamaterials across various industries.

Competitive Landscape:

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

Most market players are adopting with different strategies that help strengthen the position of the company in the market. Among them, companies are researching a lot with new developments in their R&D processes to innovate and improve the functionalities of the material so as to create more efficient, versatile, and cheaper products. They are also forging strategic partnerships and collaborations with the academic institutions, research organizations, and other companies in order to share expertise and resources with each other, thus making advancement of technology as well as its applications possible in any field. Moreover, these leaders of the market are establishing their presence across the world through mergers and acquisitions and new facility setups and are trying to penetrate newly emerging markets and also fulfill growing demands for high-tech material in various industries.

The report provides a comprehensive analysis of the competitive landscape in the metamaterials market with detailed profiles of all major companies, including:

- Acoustic Metamaterials Group Ltd
- Echodyne Corp
- Fractal Antenna Systems Inc.
- JEM Engineering LLC
- Kymeta Corporation
- Metamagnetics Inc
- Metamaterial Technologies Inc.
- MetaShield LLC
- Nanoscribe GmbH & Co. KG (Cellink AB)
- Plasmonics Inc.
- TeraView Limited

Key Questions Answered in This Report

- 1.How big is the metamaterials market?
- 2.What is the future outlook of the metamaterials market?
- 3.What are the key factors driving the metamaterials market?
- 4.Which region accounts for the largest metamaterials market share?
- 5.Which are the leading companies in the global metamaterials market?

Table of Contents:

- 1 Preface
- 2 Scope and Methodology
 - 2.1 Objectives of the Study
 - 2.2 Stakeholders
 - 2.3 Data Sources
 - 2.3.1 Primary Sources
 - 2.3.2 Secondary Sources
 - 2.4 Market Estimation
 - 2.4.1 Bottom-Up Approach
 - 2.4.2 Top-Down Approach
 - 2.5 Forecasting Methodology
- 3 Executive Summary
- 4 Introduction
 - 4.1 Overview
 - 4.2 Key Industry Trends

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 5 Global Metamaterials Market
 - 5.1 Market Overview
 - 5.2 Market Performance
 - 5.3 Impact of COVID-19
 - 5.4 Market Forecast
- 6 Market Breakup by Type
 - 6.1 Electromagnetic
 - 6.1.1 Market Trends
 - 6.1.2 Market Forecast
 - 6.2 Terahertz
 - 6.2.1 Market Trends
 - 6.2.2 Market Forecast
 - 6.3 Photonic
 - 6.3.1 Market Trends
 - 6.3.2 Market Forecast
 - 6.4 Tunable
 - 6.4.1 Market Trends
 - 6.4.2 Market Forecast
 - 6.5 Frequency Selective Surface
 - 6.5.1 Market Trends
 - 6.5.2 Market Forecast
 - 6.6 Others
 - 6.6.1 Market Trends
 - 6.6.2 Market Forecast
- 7 Market Breakup by Application
 - 7.1 Absorber
 - 7.1.1 Market Trends
 - 7.1.2 Market Forecast
 - 7.2 Antenna and Radar
 - 7.2.1 Market Trends
 - 7.2.2 Market Forecast
 - 7.3 Cloaking Devices
 - 7.3.1 Market Trends
 - 7.3.2 Market Forecast
 - 7.4 Super Lens
 - 7.4.1 Market Trends
 - 7.4.2 Market Forecast
 - 7.5 Others
 - 7.5.1 Market Trends
 - 7.5.2 Market Forecast
- 8 Market Breakup by End User
 - 8.1 Aerospace and Defense
 - 8.1.1 Market Trends
 - 8.1.2 Market Forecast
 - 8.2 Medical
 - 8.2.1 Market Trends
 - 8.2.2 Market Forecast

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 8.3 Automotive
 - 8.3.1 Market Trends
 - 8.3.2 Market Forecast
- 8.4 Consumer Electronics
 - 8.4.1 Market Trends
 - 8.4.2 Market Forecast
- 8.5 Energy and Power
 - 8.5.1 Market Trends
 - 8.5.2 Market Forecast
- 8.6 Others
 - 8.6.1 Market Trends
 - 8.6.2 Market Forecast
- 9 Market Breakup by Region
 - 9.1 North America
 - 9.1.1 United States
 - 9.1.1.1 Market Trends
 - 9.1.1.2 Market Forecast
 - 9.1.2 Canada
 - 9.1.2.1 Market Trends
 - 9.1.2.2 Market Forecast
 - 9.2 Asia-Pacific
 - 9.2.1 China
 - 9.2.1.1 Market Trends
 - 9.2.1.2 Market Forecast
 - 9.2.2 Japan
 - 9.2.2.1 Market Trends
 - 9.2.2.2 Market Forecast
 - 9.2.3 India
 - 9.2.3.1 Market Trends
 - 9.2.3.2 Market Forecast
 - 9.2.4 South Korea
 - 9.2.4.1 Market Trends
 - 9.2.4.2 Market Forecast
 - 9.2.5 Australia
 - 9.2.5.1 Market Trends
 - 9.2.5.2 Market Forecast
 - 9.2.6 Indonesia
 - 9.2.6.1 Market Trends
 - 9.2.6.2 Market Forecast
 - 9.2.7 Others
 - 9.2.7.1 Market Trends
 - 9.2.7.2 Market Forecast
 - 9.3 Europe
 - 9.3.1 Germany
 - 9.3.1.1 Market Trends
 - 9.3.1.2 Market Forecast
 - 9.3.2 France

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 9.3.2.1 Market Trends
- 9.3.2.2 Market Forecast
- 9.3.3 United Kingdom
 - 9.3.3.1 Market Trends
 - 9.3.3.2 Market Forecast
- 9.3.4 Italy
 - 9.3.4.1 Market Trends
 - 9.3.4.2 Market Forecast
- 9.3.5 Spain
 - 9.3.5.1 Market Trends
 - 9.3.5.2 Market Forecast
- 9.3.6 Russia
 - 9.3.6.1 Market Trends
 - 9.3.6.2 Market Forecast
- 9.3.7 Others
 - 9.3.7.1 Market Trends
 - 9.3.7.2 Market Forecast
- 9.4 Latin America
 - 9.4.1 Brazil
 - 9.4.1.1 Market Trends
 - 9.4.1.2 Market Forecast
 - 9.4.2 Mexico
 - 9.4.2.1 Market Trends
 - 9.4.2.2 Market Forecast
 - 9.4.3 Others
 - 9.4.3.1 Market Trends
 - 9.4.3.2 Market Forecast
- 9.5 Middle East and Africa
 - 9.5.1 Market Trends
 - 9.5.2 Market Breakup by Country
 - 9.5.3 Market Forecast
- 10 SWOT Analysis
 - 10.1 Overview
 - 10.2 Strengths
 - 10.3 Weaknesses
 - 10.4 Opportunities
 - 10.5 Threats
- 11 Value Chain Analysis
- 12 Porters Five Forces Analysis
 - 12.1 Overview
 - 12.2 Bargaining Power of Buyers
 - 12.3 Bargaining Power of Suppliers
 - 12.4 Degree of Competition
 - 12.5 Threat of New Entrants
 - 12.6 Threat of Substitutes
- 13 Price Analysis
- 14 Competitive Landscape

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

- 14.1 Market Structure
- 14.2 Key Players
- 14.3 Profiles of Key Players
 - 14.3.1 Acoustic Metamaterials Group Ltd
 - 14.3.1.1 Company Overview
 - 14.3.1.2 Product Portfolio
 - 14.3.2 Echodyne Corp
 - 14.3.2.1 Company Overview
 - 14.3.2.2 Product Portfolio
 - 14.3.3 Fractal Antenna Systems Inc.
 - 14.3.3.1 Company Overview
 - 14.3.3.2 Product Portfolio
 - 14.3.4 JEM Engineering LLC
 - 14.3.4.1 Company Overview
 - 14.3.4.2 Product Portfolio
 - 14.3.5 Kymeta Corporation
 - 14.3.5.1 Company Overview
 - 14.3.5.2 Product Portfolio
 - 14.3.6 Metamagnetics Inc
 - 14.3.6.1 Company Overview
 - 14.3.6.2 Product Portfolio
 - 14.3.7 Metamaterial Technologies Inc.
 - 14.3.7.1 Company Overview
 - 14.3.7.2 Product Portfolio
 - 14.3.8 MetaShield LLC
 - 14.3.8.1 Company Overview
 - 14.3.8.2 Product Portfolio
 - 14.3.9 Nanoscribe GmbH & Co. KG (Cellink AB)
 - 14.3.9.1 Company Overview
 - 14.3.9.2 Product Portfolio
 - 14.3.10 Plasmonics Inc.
 - 14.3.10.1 Company Overview
 - 14.3.10.2 Product Portfolio
 - 14.3.11 TeraView Limited
 - 14.3.11.1 Company Overview
 - 14.3.11.2 Product Portfolio

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com

Metamaterials Market Size, Share, Trends and Forecast by Type, Application, End User, and Region, 2025-2033

Market Report | 2025-09-01 | 135 pages | IMARC Group

To place an Order with Scotts International:

- Print this form
- Complete the relevant blank fields and sign
- Send as a scanned email to support@scotts-international.com

ORDER FORM:

Select license	License	Price
	Electronic (PDF) Single User	\$3999.00
	Five User Licence	\$4999.00
	Enterprisewide License	\$5999.00
		VAT
		Total

*Please circle the relevant license option. For any questions please contact support@scotts-international.com or 0048 603 394 346.

** VAT will be added at 23% for Polish based companies, individuals and EU based companies who are unable to provide a valid EU Vat Numbers.

Email*	<input type="text"/>	Phone*	<input type="text"/>
First Name*	<input type="text"/>	Last Name*	<input type="text"/>
Job title*	<input type="text"/>		
Company Name*	<input type="text"/>	EU Vat / Tax ID / NIP number*	<input type="text"/>
Address*	<input type="text"/>	City*	<input type="text"/>
Zip Code*	<input type="text"/>	Country*	<input type="text"/>
		Date	<input type="text" value="2026-03-04"/>
		Signature	

Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com



Scotts International. EU Vat number: PL 6772247784

tel. 0048 603 394 346 e-mail: support@scotts-international.com

www.scotts-international.com