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Global Polarization Volume Grating (PVG) Film Market Growth 2026-2032

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Abstracts

The global Polarization Volume Grating (PVG) Film market size is predicted to grow from US$ 3.08 million in 2025 to US$ 26.95 million in 2032; it is expected to grow at a CAGR of 33.4% from 2026 to 2032.

Polarization Volume Grating (PVG) Film is a functional diffractive optical film based primarily on anisotropic liquid-crystal or polymerizable reactive-mesogen materials with periodically controlled molecular orientation through the film thickness. The engineered volume structure combines Bragg diffraction, polarization selectivity, and geometric-phase control, allowing incident light to be efficiently redirected under designed wavelength, incident-angle, and polarization conditions. PVG films may operate in reflective or transmissive configurations and can be fabricated as transferable functional films or directly integrated onto glass, resin, or other optical substrates. The commercial scope of this study focuses on the PVG functional layer and its corresponding manufacturing value, including material deposition, photoalignment, polarization-holographic exposure, polymerization, curing, and related functional-layer processing. Major applications include augmented reality glasses, other head-mounted and near-eye displays, automotive head-up displays, and beam-steering or optical-communication systems. Current commercialization is concentrated particularly in diffractive waveguides, where PVG structures can perform in-coupling, pupil expansion, and out-coupling while supporting thin, transparent optical architectures. PVG has emerged as one of the important technical routes being explored for next-generation diffractive AR waveguides.

Key FindingsThe equivalent value of PVG functional layers was approximately US$10–12 per piece globally in 2025.Substrate-integrated PVG films remain the dominant product form.Augmented reality (AR) glasses are currently the largest

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application market.China is currently the most concentrated region for PVG commercialization and pilot-scale manufacturing.

Market Trends

The main technology trend is shifting from laboratory-scale polarization-holographic recording toward repeatable coating, photoalignment, exposure and curing processes suitable for larger-area and higher-throughput manufacturing. Reactive mesogens and polymerizable liquid-crystal materials enable molecular alignment in the liquid state and subsequent conversion into durable anisotropic films, while slot-die coating, inkjet deposition and multilayer processing create potential pathways toward scalable production. Another trend is the development of broadband, multilayer, multi-slant and wavelength-optimized PVG structures to improve field of view, color uniformity and angular efficiency in full-color AR systems. At the commercial level, cost reduction is becoming increasingly important: one PVG waveguide producer reported complete waveguide costs of approximately US$10–30 per piece in 2025, indicating that materials localization, process simplification and manufacturing yield improvements are beginning to reshape the economics of PVG-based waveguides.

Market Dynamics

The PVG film market is currently characterized by a combination of rapidly improving manufacturability and a still-limited installed commercial base. Demand is being pulled forward by lightweight AR glasses and near-eye displays, while supply remains constrained by relatively few organizations with proven capabilities across liquid-crystal material formulation, optical design, coating, photoalignment, holographic exposure and precision inspection. The commercialization cycle therefore depends not only on optical performance but also on yield, environmental stability, uniformity across the aperture and the ability to reproduce grating parameters at scale. The December 2025 commissioning of a dedicated PVG pilot production line provides evidence that the industry is moving beyond prototype manufacturing, although volume commercialization remains at an early stage.

Drivers

The primary driver is the need for thinner, lighter and more power-efficient optical architectures for display-enabled AR glasses. PVG waveguides can provide polarization-selective diffraction, high transparency and flexible grating engineering while maintaining a planar optical structure. The technology is particularly attractive where

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optical efficiency directly influences display-engine power consumption and battery life. Continued development of microdisplay engines, compact projection modules and AI-enabled smart glasses is increasing demand for optical waveguides that can balance brightness, transparency, weight and manufacturing cost. East China-based research and industrialization programs have already moved PVG waveguides from laboratory prototypes toward pilot manufacturing and commercial engineering cooperation.

Restraints

The largest restraint is the early maturity of the manufacturing process. PVG requires tight control of liquid-crystal alignment, coating thickness, grating pitch, slant angle, chirality, exposure conditions and polymerization uniformity. Small variations can affect diffraction efficiency, color uniformity, eyebox performance or stray light. The Society for Information Display has noted that PVH-type manufacturing has not yet reached the same level of industrialization as mature optical-film processes, even though photoalignment and scalable coating methods provide a path toward mass manufacturing. Competition from surface-relief gratings, conventional volume holographic gratings, geometric waveguides and emerging metasurface solutions also limits the addressable penetration rate of PVG rather than allowing the technology to capture the entire AR waveguide market.

Opportunities

The largest opportunity remains consumer and lightweight enterprise AR glasses, where lower optical-engine power consumption and thinner waveguide structures can create significant system-level value. Full-color PVG, multilayer structures, large-eyebox designs and two-dimensional pupil expansion are likely to receive the greatest development attention. Automotive HUD represents a secondary opportunity as holographic and diffractive optical elements are increasingly investigated for compact light manipulation, although PVG commercialization in automotive systems remains substantially less mature than in AR glasses. Additional opportunities exist in other near-eye displays, beam steering, sensing and selected optical-communication systems, but these applications should currently be treated as smaller emerging segments rather than the core revenue base.

Challenges

The central challenge is converting strong laboratory optical performance into stable high-volume manufacturing. Yield, large-area uniformity, material lifetime, temperature

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and humidity reliability, wavelength consistency and alignment accuracy must all meet consumer-electronics manufacturing requirements. Another challenge is cost allocation: PVG is typically manufactured as a micrometer-scale functional layer integrated with a waveguide substrate, so the economic value of the PVG film itself is often embedded within the finished waveguide rather than sold as an independent film. This makes standardized ASP comparisons difficult and increases uncertainty in supplier revenue estimates. Technology competition also remains significant because AR brands can select different waveguide architectures according to field of view, brightness, weight, appearance and cost targets.

Industry Chain Analysis

The upstream PVG film industry chain includes reactive mesogens and polymerizable liquid-crystal materials, chiral additives, photoalignment materials, photoinitiators, optical substrates and coating-related chemicals, together with precision coating, polarization exposure, curing and optical-inspection equipment. The midstream consists of PVG material formulation, optical design, photoalignment patterning, coating, holographic exposure, polymerization, multilayer lamination and functional-layer inspection. Downstream customers integrate the PVG functional layer into optical waveguides, optical engines, display modules and complete AR or near-eye systems. Reactive mesogens are particularly important because they can be aligned as liquid-crystal materials and subsequently polymerized into durable anisotropic optical films.

Value Chain Analysis

The highest-value capabilities are concentrated less in commodity substrate supply and more in proprietary liquid-crystal formulations, polarization-holographic design, photoalignment, exposure process control, multilayer architecture, optical simulation and high-yield manufacturing. As manufacturing scales, raw-material and coating costs are expected to decline as a percentage of finished-waveguide value, while process know-how, yield management and optical-design intellectual property remain key sources of differentiation. The declining cost of complete PVG waveguides reported in 2025 shows that process optimization can materially reduce system cost, but it also suggests that PVG functional-layer ASPs are likely to trend downward as output rises.

Segment Insights

By diffraction mode, the market can be divided into reflective PVG, transmissive PVG and others. By product form, substrate-integrated PVG film currently represents the

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principal commercial structure, while free-standing or transferable PVG film remains important for flexible integration and future high-throughput film processing. By spectral configuration, the market includes single-band and multi-band PVG, with multi-band and full-color architectures becoming increasingly important for consumer AR. By application, Augmented Reality (AR) Glasses represent the largest segment, followed by Automotive Head-up Display (HUD), Other Head-mounted and Near-eye Displays, Beam Steering and Optical Communication, and Others. The commercial center of gravity remains AR because current PVG product announcements, pilot manufacturing and engineering activity are concentrated primarily around diffractive AR waveguides.

Downstream Market Opportunities

AR glasses offer the clearest near-term downstream opportunity because optical efficiency, transparency and weight directly affect wearability and battery life. Industrial and enterprise AR applications can provide earlier adoption opportunities because customers are often more tolerant of higher system prices when hands-free visualization improves productivity. Consumer AR represents the larger long-term opportunity but imposes much stricter requirements for appearance, weight, optical consistency and cost. Automotive HUD and other optical-control applications provide additional diversification potential, but their qualification cycles, reliability requirements and system architectures differ materially from consumer near-eye displays and are therefore expected to develop more gradually.

Regional Insights

China is currently the most active region in publicly visible PVG commercialization, engineering validation and pilot production. In December 2025, a dedicated PVG waveguide pilot line was commissioned in Jiangxi, with disclosed annual capacity of around 50,000 pieces and yield above 80%, providing an important industrialization milestone. North America remains important in fundamental PVG/PVH research, optical architecture and intellectual property. Europe retains strengths in liquid-crystal materials, reactive mesogens and optical-film process development, while Japan has established capabilities in advanced display materials and waveguide engineering. At present, South Korea, Taiwan and other Asian regions show more limited publicly verified independent PVG film production, although they remain relevant through broader display and AR supply chains.

Competitive Landscape Analysis

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The competitive landscape remains highly concentrated and technology-driven rather than scale-driven. China currently has the clearest cluster of companies and industrial platforms moving from prototype development toward pilot and initial mass production, while North America and Europe remain influential through material science, optical design and foundational technology development. Japan participates primarily through advanced display, liquid-crystal and waveguide engineering capabilities. The principal competitive barriers are proprietary material systems, photoalignment and holographic exposure know-how, optical design capability, production yield, reliability validation and the ability to integrate PVG layers with different waveguide substrates. As the market moves toward higher volumes, competition is likely to shift from demonstrating optical performance toward achieving repeatable yield, lower unit cost, full-color performance and scalable customer delivery.

Report Scope

LP Information, Inc. (LPI) ' newest research report, the “Polarization Volume Grating (PVG) Film Industry Forecast” looks at past sales and reviews total world Polarization Volume Grating (PVG) Film sales in 2025, providing a comprehensive analysis by region and market sector of projected Polarization Volume Grating (PVG) Film sales for 2026 through 2032. With Polarization Volume Grating (PVG) Film sales broken down by region, market sector and sub-sector, this report provides a detailed analysis in US$ millions of the world Polarization Volume Grating (PVG) Film industry.

This Insight Report provides a comprehensive analysis of the global Polarization Volume Grating (PVG) Film landscape and highlights key trends related to product segmentation, company formation, revenue, and market share, latest development, and M&A activity. This report also analyzes the strategies of leading global companies with a focus on Polarization Volume Grating (PVG) Film portfolios and capabilities, market entry strategies, market positions, and geographic footprints, to better understand these firms’ unique position in an accelerating global Polarization Volume Grating (PVG) Film market.

This Insight Report evaluates the key market trends, drivers, and affecting factors shaping the global outlook for Polarization Volume Grating (PVG) Film and breaks down the forecast by Diffraction Mode, by Application, geography, and market size to highlight emerging pockets of opportunity. With a transparent methodology based on hundreds of bottom-up qualitative and quantitative market inputs, this study forecast offers a highly nuanced view of the current state and future trajectory in the global Polarization Volume Grating (PVG) Film.

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This report presents a comprehensive overview, market shares, and growth opportunities of Polarization Volume Grating (PVG) Film market by product type, application, key manufacturers and key regions and countries.

Market Segmentation

Segmentation by Diffraction Mode:

Reflective PVG

Transmissive PVG

Others

Segmentation by Spectral Configuration:

Single-band PVG

Multi-band PVG

Others

Segmentation by Waveguide Coupling Function:

In-coupling PVG

Pupil-expansion PVG

Out-coupling PVG

Multi-function PVG

Others

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Segmentation by Application:

- Automotive Head-up Display (HUD)
- Head-mounted and Near-eye Displays
- Beam Steering and Optical Communication
- Others

This report also splits the market by region:

- Americas
  - United States
  - Canada
  - Mexico
  - Brazil
- APAC
  - China
  - Japan
  - Korea
  - Southeast Asia
  - India
  - Australia
- Europe

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Germany

France

UK

Italy

Russia

Middle East & Africa

Egypt

South Africa

Israel

Turkey

GCC Countries

The below companies that are profiled have been selected based on inputs gathered from primary experts and analysing the company's coverage, product portfolio, its market penetration.

Goowave Technology Co., Ltd.

Nanjing Parallel Vision Technology Co., Ltd.

Nanjing Jingcui Optical Technology Co., Ltd.

Key Questions Addressed in this Report

What is the 10-year outlook for the global Polarization Volume Grating (PVG)

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Film market?

What factors are driving Polarization Volume Grating (PVG) Film market growth, globally and by region?

Which technologies are poised for the fastest growth by market and region?

How do Polarization Volume Grating (PVG) Film market opportunities vary by end market size?

How does Polarization Volume Grating (PVG) Film break out by Diffraction Mode, by Application?

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