

Preface to the special issue on “advanced optical manufacturing”

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It is our distinct privilege to introduce this Special Issue of *Light: Advanced Manufacturing* (LAM), titled “Advanced Optical Manufacturing”. This collection of invited papers and original research originates from the inaugural Light Conference on Advanced Optical Manufacturing, held in Rugao, Jiangsu Province, China, on April 16th–17th, 2024.

The conference served as a pivotal gathering for the global optics community, coinciding with the Grand Opening of the Leading Optics Rugao Factory. By uniting top researchers, industrial practitioners, investors and policy makers, the event provided a platform to address the future of advanced optical manufacturing. The discussions emphasized the necessity of bridging industry and academia to promote technological innovations and the rapid application of high-precision optical products.

Ten papers, authored by researchers from five key world economies in the advanced manufacturing sector, are collected in this issue and they represent a cross-section of the technical advancements presented in Rugao.

Large-Aperture Optics and Astronomical Instrumentation: The collection begins with a focus on the immense challenges of manufacturing and testing mirrors for next-generation astronomical telescopes. Comprehensive reviews examine the manufacturing chains for large-aperture mirrors—exceeding 3.5 meters—from material innovations like silicon carbide to the control of

full-spatial-frequency errors. Complementary research explores ground-based imaging interferometry, demonstrating how photonics and machine learning can create cost-effective, high-resolution alternatives to traditional telescope designs.

Freeform Optics—from Design to Automated Production: A major thematic pillar is the rapid advancement of freeform optics, where non-symmetric surfaces require a fundamental rethink of both fabrication and metrology. Authors investigate automated manufacturing processes that utilize effective reference structures to bridge the gap between design and high-volume production. This is supported by new developments in the prototyping of polyhedral freeform prisms and monolithic multi-freeform structures, which are vital for enhancing the performance of sophisticated optoelectronic systems.

Precision Metrology and Calibration: Ensuring sub-nanometer accuracy in making complex optics requires innovative metrology. Research in this issue introduces Bayesian multisensor fusion in deflectometry to overcome historical limitations in absolute positioning. Furthermore, the push toward “Intelligent Manufacturing” is highlighted through new calibration methods for high-speed, on-machine measurements, as well as versatile testing frameworks for aspheres and freeform surfaces.

Coatings and Computational Simulations: The technical scope also covers essential support technologies, including the progress of laser coating techniques to improve surface durability. From a computational perspective, the issue features advancements in ray-tracing efficiency through tree-like data structures, enabling faster and more accurate simulations of multi-sequential optical

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systems.

Finally, we would like to express our deepest gratitude to the host of the conference, Leading Optics and the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP, CAS), for their invaluable support. We also thank the authors for their insightful contributions and the reviewers for their commitment to the scientific excellence of LAM.

We hope this Special Issue inspires further global collaborations in the field of optical manufacturing.

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Conflict of interest

The authors declare no conflicts of interest.

Received: 16 April 2026 Revised: 17 April 2026 Accepted: 20 April 2026

Published online: 02 July 2026