

Advanced Oxide-Based Antireflective Coatings for Optical Applications



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Herein, we presents the design, fabrication, and performance analysis of multifunctional antireflective (AR) thin-film coatings using high- and low-refractive-index oxide materials, including hafnia (HfO_2), silica (SiO_2), and titania (TiO_2). The multilayer coatings were deposited on different substrates to investigate their optical performance, environmental durability, and multifunctional characteristics. By optimizing the refractive-index contrast and layer configuration, the developed coatings exhibited significantly reduced surface reflectance over a broad spectral range.

In addition to excellent optical transmission, the coatings demonstrated hydrophobic behavior, omnidirectional antireflective performance, and high thermal stability under elevated-temperature conditions. The incorporation of HfO_2 and TiO_2 as high-index materials together with SiO_2 as a low-index material enabled enhanced durability and stable optical properties. The coatings maintained their structural integrity and antireflective characteristics after thermal treatment, highlighting their suitability for demanding optical and photonic applications.

The results suggest that these multifunctional AR coatings are promising candidates for applications in solar cells, optical windows, displays, sensors, and high-temperature optical systems where low reflection, durability, and environmental stability are required.

Key Words

Oxide thin films, Optical materials, Surface engineering, Nanostructured coatings, Broadband antireflection, Durable optical coatings

Biography:

Dr. Sadaf Bashir Khan is a Professor at the School of Manufacturing Science and Engineering, Southwest University of Science and Technology (SWUST), P.R. China. She earned her PhD in Materials Science and Engineering from Tsinghua University in July 2018. During her doctoral studies at Tsinghua University, Dr. Khan received multiple prestigious academic honors, including the Comprehensive Scholarship, the 2017 Guorui Scholarship (awarded by the 14th Research Institute of China Electronics Technology Group Corporation), and the 2018 Best Dissertation Award. She also received the Outstanding Excellent Postdoctoral Inbound Award from Shenzhen university

Research Focus & Academic Achievements

Dr. Khan's long-term research centers on optoelectronics, additive manufacturing, functional materials, and advanced manufacturing processes. Her core research objective is to integrate materials science with innovative manufacturing technologies to tackle global sustainability challenges. To date, she has published more than 75 peer-reviewed academic papers (including 30 first-author papers) with a total cumulative impact factor exceeding 300, in addition to authored book chapters and authorized patents. She has been recognized with high-level talent awards at the Sichuan Provincial and municipal levels, as well as the Dongguan Special Talent Award. Dr. Khan actively contributes to the academic community as a Guest Editor for multiple renowned journals, including Discover Applied Sciences and Molecules. She has also received professional recognition for her peer-review expertise, including the 2021 Outstanding Reviewer Award (Springer Nature) and the Trusted Reviewer Award.