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Advances in Thin Film Technology: Emerging Materials, Methods, and Applications

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Abstract:

Thin film technology has emerged as a cornerstone in modern materials science, driving innovations across electronics, energy, optics, and biomedical applications. Recent advances focus on the development of novel materials, including organic-inorganic hybrids, perovskites, and two-dimensional (2D) materials, which offer enhanced electrical, optical, and mechanical properties. Parallelly, innovative fabrication techniques such as atomic layer deposition, chemical vapor deposition, spin coating, and pulsed laser deposition enable precise control over film thickness, morphology, and composition, thereby optimizing performance for specific applications. Emerging applications span high-efficiency

photovoltaics, flexible and wearable electronics, sensors, and energy storage devices, reflecting the versatility of thin films. This article reviews the latest material innovations, deposition strategies, and their functional applications, highlighting trends, challenges, and future research directions. By integrating materials science and process engineering, thin film technology continues to redefine the landscape of high-performance devices, paving the way for sustainable and next-generation technological solutions.

Keywords: *Thin Film Technology, Emerging Materials, Deposition Techniques, Nanostructured Coatings, Optoelectronic Applications.*

