Thin Film Carbon based Nanostructures Synthesized by Pulsed Laser Deposition

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Abstract

This study presents a sustainable and straightforward method for fabricating carbon-based nanostructures using pulsed laser deposition, a novel, energy-efficient, and cost-effective technique. The resulting nanostructures demonstrate remarkable potential for diverse applications across electronics, sensing technologies, and other advanced fields, offering a promising route toward next-generation functional materials.

In this work, two types of carbon-based precursors—perylene tetracarboxylic dianhydride and multi-walled carbon nanotubes (MWCNTs) blended with polyvinyl alcohol (PVA) as a binding agent, were employed to synthesize nanostructured thin films via pulsed laser deposition. The films were deposited by IR CO2 pulsed laser onto various substrates under vacuum conditions by optimizing the number of pulses, followed by thermal annealing to enhance their structural and functional properties. Characterization techniques including infrared, ultraviolet-visible spectroscopy, and scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDX) were used to evaluate the films composition and morphology. Electrical properties were assessed using the four-point probe resistivity method. Notably, both types of films exhibited comparable structural characteristics, while the MWCNT/PVA-derived films demonstrated superior electrical conductivity after annealing.

This study highlights pulsed laser ablation as a powerful, energy-efficient, and environmentally friendly technique for the fabrication of carbon nanostructures, offering an optimal balance between cost-effectiveness, precision, and material sustainability.

Keywords

Carbon nanostructures, pulsed laser deposition.