Thin Film Materials and Devices

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As the sizes of materials decrease from a macroscopic scale to smaller ones, many unique physical and chemical properties of the materials become prominent. Thin film materials, in the size from a few nanometers to micrometers, have chemical, optical, electrical, magnetic, thermal, mechanical, acoustic, and other properties different from bulk materials due to the large surface to volume ratio, quantum confinement effects, and many other interesting effects. For example, when transforming to a thin film, inert materials may turn into active catalysts, stable materials may become unstable, and opaque materials turn into transparent (e.g. ITO, Cu, and FTO). Thus, the unique surface phenomena for thin film materials have created many interdisciplinary science and engineering areas, ranging from chemistry, physics, electronics, and biology to engineering.1 Thin film materials and technologies (in nano and microscale) have served as enabling technology in diverse fields, such as catalysts for environmental applications and CO₂ capture and conversion;2-4 antibacterial applications;5 enhanced mechanical strength; semiconductor;6 improved energy efficiency for solar cells7, 8 and energy storage devices;8,9 sensors;10 light-emitting devices,11-14 electrochromism,15,16 and so on.

The suitability of the thin film for a particular application is dependent upon their morphology and stability. The morphology and the stability on the thin film hinge to the deposition techniques. In the present era of technology, there are constant and continuous demands of new materials for multitudinous applications, in which thin films play an important role. This issue of ES Materials and Manufacturing presents the latest developments and advances in the field of thin film nanomaterials with special attention to the synthesis, and applications of thin films. It broadly covers thin film-based nanomaterials, their synthesis, and applications in sensing, photocatalysis and photovoltaics.

In the present issue, Jadkar et al. reported the synthesis of TiO₂ thin films by using a simple, inexpensive, low-temperature chemical bath deposition (CBD) method followed by annealing at 300, 400, and 500 °C, and the obtained TiO₂ thin films were sensitized with melanin. The influence of annealing temperature on the structural, optical, morphology, and photoelectrochemical cell properties were investigated using a variety of techniques. Sannakki et al. prepared Gold (Au) nanoparticles by electrochemical deposition of an aqueous solution of auric chloride (AuCl₄⁻) on a titanium dioxide (TiO₂) film. Before and after the electrochemical deposition, the TiO₂ film was soaked into the dye solution of Rose Bengal. It was found that the photoelectrochemical properties enhanced after the deposition of Au nanoparticles.
on the TiO₂ film. Lokhande *et al.* reported successive ionic layer adsorption and reaction (SILAR) deposited Cu₃SnS₄ (CTS) thin films. This study gives promising results in developing photovoltaic devices using SILAR CTS as the absorber.

Bangi *et al.* reported the influence of a glycerol additive on the chemical structure, hydrophobicity, morphology, and optical properties of a sol-gel based zirconia coating. Experimental results reveal that the porous morphology of the zirconia coatings leads to an optical transmission larger than 90%.

Guo and Zhang *et al.* fabricated an alternating multilayer polydimethylsiloxane resin nanocomposite coating for anti-corrosion purposes, which exhibits the best corrosion resistance at a 4.82 V corrosion potential (Ecorr). Palve *et al.* reported the synthesis of copper selenide nanocrystals on a glass substrate by a chemical bath deposition technique and investigated the reaction between Cu-ions and selenosulfate in an aqueous solution that forms Cu₃Se₂ at room temperature. Pathan *et al.* presented the synthesis of Eosin-Y sensitized bi-layered ZnO nanoflower-CeO₂ photoanode for DSSCs. The results show that a nanoflower morphology and a porous, rough and spongy morphology of CeO₂ are effective for dye adsorption.

Jadkar *et al.* reported the synthesis of an n-type hydrogenated nanocrystalline silicon (nc-Si:H) thin film using silane (SiH₄) and phosphine (PH₃) acting as dopant gases by a catalytic chemical vapor deposition technique (Cat-CVD). The optoelectronic and structural properties of nc-Si:H have been studied, which shows that the deposited film can be useful as n-layer Si:H based c-Si hetero-junction solar cells. Zhang *et al.* prepared hollow spheres/epoxy resin encapsulated steel pipe structures by using Al₂O₃ hollow spheres with macromolecule materials for encapsulation and studied their damping properties.

In summary, thin film-based nanomaterials have great potentials for various applications with new capabilities. This important field of research will continue to grow undoubtedly and *ES Materials and Manufacturing* welcomes manuscripts that describe thin film synthesis and exciting new nanomaterials-based on thin films along with the innovative applications that they enable.

References


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