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Editorial

Editorial for the Special Issue "Organic/Metal Oxide Thin Films for Optoelectronic/Photovoltaic and Sensing Applications"

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The Special Issue entitled "Organic/Metal Oxide Thin Films for Optoelectronic/ Photovoltaic and Sensing Applications" is comprised of thirteen original research articles devoted to the development and designing of new and novel organic/metal oxide thin film-based nanomaterials (NMs) for electrochemical and optoelectronic applications.

In recent times, NMs (particularly the modified thin film-based nanoassemblies (NAs)) have emerged as a prominent research domain, offering a multi-dimensional solution for the synthesis of unique materials with salient electrochemical properties. The development of facile modification strategies (such as nanocomposite formation, surface alteration of the pre-synthesized thin film with NMs, novel NMs embedding protocols, etc.) has led to a remarkable increase in the publication of innovative case studies for numerous practical applications. These modification methodologies have resulted in alterations in the way in which these assemblies interact with electronic, electromagnetic and chemical stimuli, and consequently, exceptional results have been observed in the applicability potential of these high-performance materials for the optoelectronic and electrochemical applications. In tandem, this Special Issue highlights the significance of the novel modification strategies essential for modulating the interaction characteristics, as well as the practical applicability potential of the organic/metal oxide thin film-based NAs.

The controllable synthesis of NAs is essential for tuning peculiar properties of the materials, and therefore, aids in designing the material for the relevant application. Ahmad et al. [1] documented an exceptional study regarding the effect of the substitution of the Galium ions (Ga^{3+}) in Lithium conducting garnets ($Li_{5+2x}La_3Ta_{2-x}Ga_xO_{12}$) for improving the relaxation and ionic conductance properties of these NAs. The substitution of the Ga^{3+} in the parent lattice of the garnet increased the hopping frequency, lithium-ion mobility, and dielectric constant values of the materials making it a more suitable material for Lithium-ion battery-based applications. Abd-Elkader et al. [2] also utilized the substitution approach for enhancing the magnetic and gas-sensing characteristics of the cobalt ferrite nanoparticles (NPs). The authors doped the ferrite NPs with the tungsten ion (in different concentrations, i.e., $0.0 \leq x \leq 0.15$) and found that the lattice parameter values exhibited increment with the enhanced doping concentrations. The magnetic saturation and structural characteristics also experienced variation with the introduction of the dopant. The doped material exhibited enhanced selectivity and sensitivity for the sensing of the acetone, indicating that the operation of the acetone sensor can be tuned by using the doped NAs. Kumar et al. [3] utilized a similar approach of substitution to enhance the optical, structural, ferroelectric and magnetic properties of the Bismuth ferrite NPs. The authors performed a manganese substitution in the Bismuth ferrite lattice by using the sol-gel technique followed by annealing at a high temperature of 550 °C. The reported changes include a reduction in bandgap values, strain, crystallite size and lattice parameters, and the narrowing down of the hysteresis loop was observed in the case of the addition of the dopant. Althobaiti and Hawwa [4] presented a copacetic study on thick piezoelectric films (PZf) and performed the analysis associated with the bending wave propagation in PZf placed on the Winkler–Fuss foundation. A novel numerical approach was elected to

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acquire information regarding the dynamics involved in the propagation of the harmonic wave in the PZf. It was discovered that the increment in the Wrinkler's constant increased the critical velocity.

Apart from the utilized modification methodology of substitution/doping, the synthetic methodology/protocol used for achieving the modification is also crucial for achieving enhanced results. Alam et al. [5] utilized the sputtering technique for synthesizing the aluminum and copper-doped zinc oxide (ZnO) nanofilms (NFs) and found that the sputtering technique was quite effective for enhancing the electrical, optical and structural characteristics of these materials. Upon assembling the solar cells by utilizing these doped NFs as photoelectrodes, the efficacies of 0.59% and 0.492% were observed in the case of copper and aluminum ZnO NFs. Ansari et al. [6] utilized the solvothermal methodology to synthesize the three-dimensional nickel sulfide (NiS) nanofoams (Nfs), exhibiting two different morphologies of wrinkle and nanogranular-shaped structures. The authors identified that the morphology is critical for achieving higher supercapacitive applications with the wrinkle-shaped morphology exhibiting better results compared to the angular Nfs. Ahmad et al. [7] utilized the sol-gel methodology for manufacturing titanium dioxide (TiO_2) NPs and implemented the synthesized NPs as a photocatalyst and catalyst for numerous reactions. The synthesized NPs effectively synthesized benzoic acid via the oxidation reaction and degraded the 4-nitrophenol pollutant via the reductive reaction.

Another modification methodology implemented for improving the applicability of the NAs is the development of nanocomposites (NCs), i.e., an assembly containing more than one NM in the system. It is beneficial compared to the single NM-based assembly as NCs exhibit the synergistic effects of both the NMs at a single platform. Ansari et al. [8] synthesized the silver NPs embedded in the reduced graphene oxide (rGO) and further wrapped this assembly over manganese oxide (MnO_2) rods to synthesize the NCs. The embedding of Ag NPs and the formation of NCs assembly (Ag-rGO@MnO_2 NCs) both enhanced the capacitive potential of the synthesized system. Alam et al. [9] utilized the hydrothermal assisted sol-gel methodology to design the NCs disc-shaped $MgCo_2O_4$ nanostructures, further supplied with zinc sulfide (ZnS) NPs for enhanced supercapacitor applications. Apart from enhancing the capacitive potential, the ZnS coating played an active role in hindering the side reactions and electrode decomposition reactions in the medium. Ansari et al. [10] utilized nickel foam (Nif) as a substrate and directly grew NMs ($NiZn_2O_4$) over it to acquire the NCs. The $NiZn_2O_4$@Nif NCs worked as a binder-free capacitive material for electrode formation in supercapacitor applications.

Rather than utilizing the morphology of thin films, the organic/metal oxide assembles can exist in other forms as well. Alam et al. [11] utilized the green synthetic approach for synthesizing copper oxide (CuO), nickel oxide (NiO) and ZnO NPs for photocatalytic and sensor-based applications. The synthesized NPs exhibited moderate photocatalytic degradation efficacy against Acid Red 88 dye. Okada et al. [12] utilized a complicated procedure to develop the perovskite photochemical material possessing titanium oxide (TiO_2) NPs and deposited it over polyethylenimine ethoxylated (PEIE) to develop highly sensitive optoelectronic material for the light-emitting diodes or organic thin-films transistor (OTFT)-based applications. Alghamdi et al. [13] took the work one step further and presented a comparative paper for investigating the accuracy of two methodologies (transition voltage method (TVM) and transfer line method (TLM)) for measuring the contact resistance in OTFT assemblies. Testing the OTFT assemblies with numerous semiconductor active layers reveals that TVM is a more precise methodology to investigate the electrochemical parameters of these assemblies.

To conclude, the remarkable advancements documented regarding the organic/metal oxide thin film-based assemblies highlight the significance of the high practical applicability potential of these materials for electrochemical and optoelectronic applications. We hope that this Special Issue will act as a guideline for the future perspective to be explored for this particular research domain.

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