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Editorial

Surface Innovations

Editorial

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In this second issue of 2024, we present a review on the development of nickel oxide/magnesium oxide solid solution catalysts.[1] Additionally, we feature original research reports on the following topics: biological synthesis of copper oxide nanoparticles and their optoelectronic properties,[2] electrical conductivity of printed carbon paste films doped with silver nanowires,[3] argon beam irradiation of polyvinyl alcohol/copper oxide composite films for optical applications,[4] functionalization of medical-grade titanium alloy with KR-12 peptide,[5] electrodeposited nickel-phosphorus coatings on magnets,[6] and theoretical investigation of localized surface plasmon resonance properties of gold dimeric nanobipyramids.[7]

In the Invited Feature Article,[1] Chen and Hu present a comprehensive literature review on the development of nickel oxide/magnesium oxide (NiO/MgO) solid solution catalysts. These catalysts are particularly effective in preventing coke formation and sintering during processes such as dry methane reforming. The review clarifies the principles behind the reduction of NiO/MgO solid solutions, discusses various synthesis methods, and explores their catalytic applications. NiO/MgO solid solutions excel in functional processes, including dry methane reforming, carbon dioxide (CO_2) hydrogenation, methane partial oxidation, and the steam reforming of hydrocarbons. The similar lattice parameters of NiO and MgO facilitate homogeneous solid solution formation, allowing metallic Ni particles to form through the reduction of NiO. The small size of these Ni particles is crucial for minimising carbon deposition and sintering during catalytic reactions. The authors discuss the fundamental principles underlying the formation and reduction properties of NiO/MgO solid solutions, as well as the factors contributing to their high catalytic activity. They also review various methods for synthesising these solid solutions and provide an overview of recent advancements in their catalytic applications. This thorough and clearly articulated work adds significant value to the broader scientific community.

Researchers from India and Saudi Arabia have studied the green synthesis of copper oxide (CuO) nanoparticles using mango leaf extracts.[2] The CuO nanoparticles, with an average crystallite size of 18 nm, are impurity-free and belong to the monoclinic phase. They exhibit an absorption peak at 338 nm and a calculated band gap energy of 2.2 eV. The needle-shaped nanoparticles have an aspect ratio of 5:40 nm. Fourier-transform infrared analysis indicates that bioactive compounds from the leaves aid in nanoparticle formation. Photoluminescence studies show emission bands in various colors. The electrical conductivity is measured at $\sim 1.4 \times 10^{-7}$ S/m at 100°C and $\sim 5.2 \times 10^{-7}$ S/m at 200°C. These environmentally friendly CuO nanoparticles have potential applications in resistive sensors, solar cells, and optoelectronic devices.

Silver nanowires are gaining attention for their potential in conductive films, flexible electronics, EMI shielding, sensors, and wearable devices. In a new original contribution, Das *et al*.[3] developed conductive inks with tailored viscosities, optimising formulations for various printing techniques by incorporating silver nanowires into carbon paste in N-dimethylformamide. Flexible circuits were printed on silk film substrates, and their electrical resistance was tested by varying silver nanowire concentrations and printed layers. Results showed that a concentration of 30 mg/ml significantly reduced film resistivity, with screen-printed films demonstrating the lowest resistivity and longest service life, highlighting their great potential in flexible electronics.

Next, Atta *et al*.[4] investigate the structural, surface, and optical properties of irradiated polyvinyl alcohol/copper oxide (PVA/CuO) polymer composite films, which were prepared using a solution casting method to enhance their suitability for optoelectronic applications. The films were irradiated with an argon ion beam at fluences ranging from $(3–9) \times 10^{17}$ ions/cm^2. Key findings from the study indicate that irradiation reduced the crystallite size of CuO from 16.5 nm to 11.2 nm and decreased the band gap from 3.75 eV to 3.06 eV. Additionally, there was an increase in both the refractive index and optical conductivity. Phase analyses revealed structural modifications, such as an increase in dislocation density and strain, which improved the optical characteristics of the films. These enhancements, including improved non-linear optical responses, suggest that the irradiated PVA/CuO composites are highly suitable for use in flexible optoelectronic devices.

A research team from Turkey is investigating an innovative method to improve titanium implants using the antimicrobial peptide KR-12.[5] They compare two immobilisation techniques: direct covalent binding via. carbodiimide (CDI) and polydopamine (PDA)-mediated binding. While CDI is commonly used, PDA has recently received attention for its effectiveness in surface functionalization.

The study evaluates the immobilisation efficiency and antibacterial effectiveness against *Staphylococcus aureus*, alongside in vitro tests with rat bone marrow-derived mesenchymal stem cells to assess cell adhesion, proliferation, and osteogenic differentiation. This comprehensive analysis identifies the most effective bioactive coating for titanium surfaces, addressing clinical challenges related to infection and osteointegration.

Neodymium-iron-boron (Nd-Fe-B) magnets are characterized by a tetragonal crystal structure. These magnets are lightweight and offer high specific power, which makes them widely used across various industries. Their applications range from radar technology, satellite communications, and rail transit to wind-driven motors, elevator traction motors, refrigerator and air conditioner motors, electric bicycle motors, as well as in speakers, microphones, electro-acoustic sensors, and many other uses in the automotive, electronics, and medical fields. Due to their unique phase structure, Nd-Fe-B permanent magnets require high levels of corrosion resistance. In a captivating new study,[6] Xu *et al*. investigated the corrosion properties of nickel-phosphorus (Ni-P) coatings, which were produced on Nd-Fe-B magnets using pulsed electrodeposition. The researchers carried out structural characterisation, mechanical property measurements, and corrosion property evaluations of the synthesized Ni-P coatings. They successfully created Ni-P coatings with various crystallographic orientations and levels of crystallinity by controlling different pulse currents and electrolytes during the pulsed electrodeposition process. This significantly enhanced the corrosion resistance of the coatings.

In the final contribution to this issue, a research team from Guilin University of Electronic Technology in China explores the structural characteristics of gold monomer nanobipyramids and the coupling effects observed in dimers.[7] By controlling the structure, morphology, and surrounding medium, the authors demonstrate through simulations using the finite difference time domain method that it is possible to achieve higher extinction intensity, significant field enhancement, and high sensing capabilities. The simulation results indicate that reducing the gap between gold dimeric nanobipyramids significantly enhances both the total extinction intensity and the electric field enhancement effect. Additionally, increasing the sharpness of the gold dimeric nanobipyramids can lead to the appearance of a third extinction peak, expanding the range of detectable resonance phenomena. The sharper the structure, the stronger the electric field enhancement. The gold dimeric nanobipyramids exhibit excellent and consistent localized surface plasmon resonance (LSPR) characteristics in different media, highlighting their high sensitivity to environmental changes. The resonance peak shows a linear redshift as the refractive index increases. This work showcases the outstanding optical and electric field properties of gold dimeric nanobipyramids, as well as their potential applications in various fields such as medicine, chemistry, environmental science, and photonic waveguides.

We welcome your feedback and suggestions to help improve *the Surface Innovations* journal for our readers in the future. We also invite comprehensive reviews and original work related to surfaces, interfaces, and coating science, engineering, manufacturing, and performance.

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