Topical Symposium on Sustainable Surface Engineering
Room Golden State Ballroom - Session TS2-ThP
(Photo)electrocatalysis and Solar/Thermal Conversion Poster Session

TS2-ThP-1 Heteroepitaxial Growth of $ZnTiN_2$ for Optimization of Optoelectronic Properties, ***Mellie Lemon***, *John Mangum,* National Renewable Energy Laboratory, USA*; Anna C. Kundmann,* University of California at Davis, USA*; Andriy Zakutayev, Ann L. Greenaway,* National Renewable Energy Laboratory, USA

The n-type semiconductor, $ZnTiN_2$, has been proposed as a potential photoabsorber in devices for CO_2 reduction. Previous studies of this material focused on the characterization of its properties and optimization of its synthesis. These studies revealed that $ZnTiN_2$ films exhibit cation-disorder, which reduces the bandgap to ~2eV and that the films form passivating oxide layers under conditions relevant for CO_2R. Additionally, the crystalline quality and optoelectronic properties of $ZnTiN_2$ can be improved through heteroepitaxial deposition on sapphire substrates at elevated temperatures and by the addition of ~10 cation % Sn. This study builds on this work to further improve the optoelectronic properties by optimization of the synthesis to reduce unintentional dopants. Removal of defect states in the bandgap reduces the sub-bandgap optical absorption and lengthens photoexcited carrier lifetimes. The films in this study are deposited by reactive RF co-sputtering at elevated temperatures, with optical and electronic measurements and photoelectrochemical experiments used to determine the properties. Characterization of $ZnTiN_2$ via multiple complementary techniques will lead to fundamental insight into the structure-property relationships of this material and insight into how to improve its efficiency for PEC applications. Future efforts will focus on examining the role of polarity on charge transport in $ZnTiN_2$and across its interfaces.

TS2-ThP-2 Synthesis and Photocatalytic Efficiency of Bismuth-Copper Selenide Chitosan Microspheres for Micropollutant Degradation under Solar Radiation, ***Sayed Suliman Shah***, The Molecular Innovation and Applications Laboratory (LIMA), University of Strasbourg, France

Among the top trending environmental concerns, water pollution has got a serious attention these days. Technological advancement in industrial sectors for manufacture of diverse products particularly micropollutants is the principle reason by discharging the wastewater of unit operations. In this context various percussive strategies have been followed among which photocatalysis is considered cheap, ideal and eco-friendly in nature . In this work, an effort has been made to have synthesize an effective catalyst bismuth-copper selenide chitosan microspheres via solvothermal process in order to degrade micropollutants in wastewater under solar radiations. The synthesized catalyst nano composite was fabricated withpolyaniline (PANI) being conductive in nature for better photocatalytic efficiency and characterized with FTIR, SEM, EDX and XRD. The photocatalytic nature of the catalyst was examined by varying different variables namely pollutant concentration, catalyst dose, pH, degradation time and batches.

TS2-ThP-3 Dual-Metal Doped Perovskite Oxides: High-Performance Fenton-Like Catalysts for Antibiotic Degradation, ***Thi Xuyen Nguyen***, *Yong Yu, Chia-Ying Su, Jyh-Ming Ting,* National Cheng Kung University (NCKU), Taiwan

Water pollution from organic wastewater has become a significant global concern. The Fenton-like process is an effective and practical method for reducing organic pollutants. In this study, we synthesized a dual-metal of Cu and Mn co-doped in $LaFeO_3$ perovskite oxide using a simple co-precipitation method. The obtained $La(FeCuMn)O_3$ achieves a remarkable 90.3% removal rate of high-concentration tetracycline (40 ppm) within 30 min without requiring additional light irradiation. This performance is six times higher than that of pristine $LaFeO_3$ and surpasses that of single-metal-doped samples ($LaFeCuO_3$ and $LaFeMnO_3$). We found that the oxygen vacancies induced by doping can enhance the pollutant adsorption, while Cu^+ facilitates the regeneration of Fe^{2+} and Mn promotes charge redistribution. The synergistic effects of dual-metal co-doping substantially enhance Fenton activity.

TS2-ThP-4 3D Atmospheric Plasma Beam TiO_2 Lamination of Porous Structures for Manufacturing Electro-Photocatalytic Reactors, ***Yuri Glukhoy***, Nanocoating Plasma Systems Inc, USA*; Michael Ryaboy,* nanocoating plasma systems inc, USA

Nanocoating Plasma Systems has developed electro-photocatalytic (EPCO) reactor with matrix's honeycomb structure made from welded together quartz capillaries with ID 0.5 mm and 7 mm long/ Due to such a design component like electric field applied to the matrix can increase the area of disinfection. When exposed to moisture (water vapor) and light, TiO2 undergoes excitation that produces electron-hole pairs, which in turn react with water molecules to form $OH^{\cdot}$ and other reactive species, this reaction is further enhanced by the electric field which not only accelerates the production of hydroxyls but also drives their propagation into the surrounding space. This phenomenon called chain reaction is the process, where the ejected from the matrix and energized by a high voltage hydroxyl radicals collide with water molecules in the room to produce secondary hydroxyl radicals. It is essential for extending the disinfecting effects over larger areas and reducing pathogen concentrations rapidly. NPS have used the focused the RF plasma beam carrying the TiO2 nanoparticles is commonly employed to provide the 2D nanocoating for different application. However, transition to the TiO2 lamination of the 3D object like the matrix with the capillaries' holes with a high aspect ratio is complicated by the negative charge passivating the entrance of these holes and rejecting the beam. ionize gases and control plasma behavior at atmospheric pressure. This phenomenon called Debye Plasma Law makes impossible lamination of the matrix. To breach this law NPS has applied the auxiliary RF discharge at the exit of the capillary holes. It generates the hollow discharge inside the hole neutralizing the parasitic charge at the entrance. Therefore, the plasma beam is able to penetrate into the interior of the holes, where the TiO2 coating is deposited on the inner walls. This technique not only overcomes the challenges of applying uniform coatings to complex geometries (such as the small and intricate capillary structures) but also, taking in account the electrical component, ensures enhancing chain reaction to enlarge the disinfection area. Involving the RF plasma beam helps to solve another problem like a low photo-catalytic activity of the commercial TiO2 nanoparticles with a bandgap about 3.2 eV limited just by UV that includes just 4% of solar spectrum. Therefore, besides generation the fine plasma beam, the nitrogen plasma discharge provides the N-doping of the TiO2 nanoparticle generates the fine plasma beam particles reducing the bandgap up to 2.75 eV for absorption of all spectrum of visible spectrum.

Author Index

Bold page numbers indicate presenter