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A Huge Challenge in Preparing Inorganic Nanomaterials with Special Morphology

Dhayal Yang*

Department of Chemistry, Beijing Advanced Innovation Center for Biomedical Engineering, Beihang University, Beijing, China

***Corresponding author**: Dhayal Yang, Department of Chemistry, Beijing Advanced Innovation Center for Biomedical Engineering, Beihang University, Beijing, China, Email: yangdhayal77@gmail.com

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Description

Vanadium pentoxide (V_2O_5) thinfilms were deposited under a variety of conditions with the new Hot Filament Chemical Vapor Deposition (HFCVD) method. The thinfilms' response to gas sensing and structural characteristics were examined. The thin films are orthorhombic V_2O_5 with the preferred orientation (001), as demonstrated by X-ray diffraction. Nanorod thinfilms can be made using optimized oxygen content and substrate-to-filament distance, as seen by scanning electron microscopy. The nanorod thinfilm's sensitivity to ethanol and ammonia was evaluated. It has a sensing response of 1.557 and 1.721 to 200 ppm ethanol and ammonia, respectively. After being exposed to ethanol and ammonia, it takes 14 seconds and 20 seconds to respond, and it takes 26 seconds and 38 seconds to recover. Preparing inorganic nanomaterials with unique morphologies is currently a huge challenge. In this work, nitrilotriacetic acid is first used to make -MnOOH nanorods with a diameter of 15 nm and a length of 100 nm. Under calcination at 400 °C, MnO_2 with the inherited morphology is also obtained. Several methods are used to analyze the resulting samples' structures in depth. Both nanorods exhibit satisfactory electrochemical properties when used as super capacitor electrodes, including high specific capacitances, excellent capacitance retention, and kinetics. This is due to the distinct structure of the nanorods, which facilitates shorter distances for ionic/electron diffusion and lower strain relaxation. In addition, the asymmetric super capacitors made with activated carbon as the negative electrode have the highest energy/power densities, with 30.5 Wh kg1/0.7 kWh kg1 for -MnOOH nanorods and 18.2 Wh kg1/0.5 kWh kg1 for -MnO_2 nanorods, respectively. These results suggest that these super capacitors could be used in the future.

Nanorods with H_2O_2

It is generally accepted that improving the electrochemical performance of Super Capacitors (SCs) can be accomplished through the design and improvement of electrode materials. By engineering the nanostructure and oxygen vacancies of electrodes, it is an appealing method for obtaining high capacity electrodes. By oxidizing Co nanorods with H_2O_2, we were able to significantly boost the electrochemical energy storage of one-dimensional (1D) Co_3O_4 nanorods with abundant oxygen vacancies. In this paper, we present an environmentally friendly method for doing so. Due to their unique 1D nanostructure and oxygen vacancy, these Co_3O_4 NRs have a high specific capacity of 627.4 mF cm2 and excellent rate capacity (57.8 percent capacitance retention at 10 mA cm^2). Additionally, the Co_3O_4 nanorods used as electrode materials in an Asymmetric Super Capacitor (ASC) have a high energy density of 0.187 mWh cm^2 and a power density of 1.261 mW cm^2. The work's approach to nanostructure and vacancy engineering serves as a model for the next generation of SCs' design. Biomimetic materials with a protruding structure have been created by using a hydroxyl-localized droplet templating technique that uses polyvinylpyrrolidone as a surfactant and sodium citrate as a stabilizer to form the droplets. This method was inspired by the Lotus-Effect that occurs naturally. On the surface of high silica fibers, silica nanorods develop uniformly and densely in a unidirectional fashion. The aspect ratio of the nanorods can be changed from 1.73 to 17.58 by adjusting the concentration of the reagent and the conditions of the reaction. Additionally, the length and diameter of the nanorods can be controlled from 180 to 368 nm and from 194 to 1489 nm, respectively. In the meantime, the structure also undergoes transformations from straight rod-like shapes to curved linear shapes with up to 1.50 degrees of curvature.

The hydroxyl group on the fiber surface, which participates in the condensation reaction of tetraethyl orthosilicate and adsorbs the attachment of emulsified droplets, is found to be the key to the in-situ growth of silica nanorods. In addition, biomimetic materials with protruding structures can be produced by growing silica nanorods on mullite and basalt fibers with success. On mullite and basalt fibers, silica nanorods have mean lengths of 833 nm and 1361 nm, respectively, and mean diameters of 379 nm and 271 nm. In a fast, flexible, and ultrasensitive mode, Surface Enhanced Raman Spectroscopy (SERS) provides a tremendous opportunity to detect food additives. For the purpose of SERS sensing of food preservatives like ethylparaben, we developed AgNPr-functionalized Zinc Oxide (ZnO) hetero architectures in this study. Through a simple hydrothermal process, it was discovered that ZnO nanorods formed and organized into a morphology similar to that of a sea urchin. The nanorod length increased from 500 to 1900 nm when the growth time was changed from 3 to 72 hours. Absorption and vibrational modes were well correlated with the effect of the morphology of the substrates as they were being constructed. Besides, silver nanoprisms with unconventional three-sided morphology with a size scope of 20-80 nm were incorporated for functionalizing ZnO clusters; whose inclusion was further supported by EDS and XPS analysis. SERS research revealed that the length of the nanorods influenced the synergistic Raman signal enhancement of AgNPr/ZnO NRs assembly. Substrates with nanorod lengths of less than 1500 nm had the highest SERS activity. The optimized AgNPr/ZnO NRs substrates' reproducibility and reusability were also demonstrated. Real-time, highly specific EP sensing down to pico-molar levels was demonstrated by the developed sensor; could be a good candidate for food safety applications that require rapid, in-place identification of food preservatives.

Substrates with Nanorod Lengths

The overuse of synthetic phenolic antioxidants like 2,6-Di-t-butyl-p-hydroxytoluene raise health concerns and call for careful monitoring and evaluation. With the development of a semiconductor/metallic junction (1D ZnO nanorods/silver nanotriangles) sensor on a stainless steel substrate, Surface Enhanced Raman Scattering (SERS) is investigated as a prominent method for the direct detection of food additives. Substrates made of stainless steel are inexpensive, highly thermally resistant, enhance Raman signal strength, and reduce background signal fluorescence. The influence of growth parameters on the nanorod length is optimized. The surface of ZnO nanorods (ZNR/AgT) is sensitized by silver nanotriangles (AgT).The cross breed nanostructures underlying, morphology and optical property are examined exhaustively. ZnO nanorods with a length of 0.49 m and a 3 h growth interval were used to create a highly sensitive sensor (Z3/AgT).With the point of synergism, the underlying mechanisms of ultra-sensitivity are brought to light. The synergistic mechanism results in a 5.2-fold increase in sensitivity. The constructed Z3/AgT sensor detects the food additive BHT at a very low concentration (0.1 ng/mL) with extreme sensitivity and extreme uniformity (RSD values -8.3%).In order to maintain food safety, the developed sensor is perfectly suited for on-site monitoring of foods. A novel CVD method at 1300 °C pretreatment of precursors with aqueous NH3 yields square-shaped, high-quality GaN nanorods. GaN nanorod conductivities, carrier concentrations, and mobilities were significantly enhanced by the pre-treatment effect. Additionally, precursors have not been treated with aqueous NH3 during the production of GaN nanowires at 1300°C. Breadth of the nanorods and nanowires are estimated in the scope of 100-200 nm while length is in 10th of microns. GaN nanowires underwent PL analysis at room temperature, revealing week blue emission with high intensity near the band edge at 370 nm. The GaN square nanorods had near-band-edge emission at 369 nm and yellow band emission at 565 nm, both of which disappeared. This suggests that they could be used in optoelectronics. For nanowires and nanorods, the calculated carrier concentrations (Nd) are 3.65–5.25, 1016 cm^3 and 2.25–5.88, 1018 cm^3, respectively. The calculated electron mobilities for the GaN nanowires ranged from 200 to 300 cm^2/Vs, whereas those for the nanorods ranged from 154 to 625 cm^2/Vs. The excellent GaN nanorods building blocks with high conductivities, profession densities and mobilities will be an enormous forward leap in low voltage working nano-gadgets. Materials that can absorb broadband microwaves have always been the goal of ongoing research. One way to improve broadband Microwave Absorption (MA) performance is to use impedance-matched design and a hierarchical interfacial structure. However, designing magnetic-dielectric structures using delicate hierarchical interfacial engineering remains an ongoing challenge. The novel $La(OH)_3$ nanorods have been successfully synthesized in this work, and the $La(OH)_3$ nanorods have been randomly anchored on the surface of the metal–organic framework (ZIF-67) to form a hierarchical and controllable precursor. The La_2O_3 nanorods are distributed on the surface of the Co/C polyhedral following a strenuous pyrolysis process at high temperatures. Because of the appropriate impedance matching, the MA performance of the LaCoC-700 nanoparticles is superior. At a thickness of 3.37 mm, the LaCoC-700 has an effective absorption bandwidth of 8.56 GHz (9.44–18 GHz) and a minimum reflection loss of 63.0 dB. The interface effect and impedance matching can be enhanced, for example, by incorporating La_2O_3 nanorods. The dielectric carbon and magnetic cobalt core can effectively attenuate microwave using the synchronous loss process. For the purpose of creating broadband microwave absorbers, a high and low dielectric loss combination strategy is presented in this work.