(Nickel) Substrate Nano-ZnO Dye-sensitized Solar Cell Preparation and Performance Research

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Abstract. With the rapid growth and development of the world and global economy, human material and living standards continue to improve and improve, people's demand for renewable energy has become more and more, and many traditional energy sources, such as oil, natural gas, coal, etc., due to their limited storage capacity, serious environmental pollution during mining, and many other reasons, no longer fully meet the human demand for sustainable use of renewable energy in our era. Therefore, the development of a clean industrial energy is gradually becoming an important solution for contemporary Chinese enterprises to solve the problem of clean industrial energy utilization. Solar cells are an inexhaustible clean and green energy. It has great research and development and application value. It has attracted extensive research attention from social scientists. Among them, solar energy dye-sensitized battery solar plastic cells mainly have The dye process is simple, the cost of the preparation process is low, the conversion efficiency is high, and the large-scale production can be achieved throughout the year. Therefore, it has gradually become a hot spot in my country's solar power battery technology research in recent years. This article aims to study the preparation and performance of (nickel) substrate nano-ZnO dye-sensitized solar cells. The optimal conditions for the synthesis of ZnO and the influence of different reaction conditions on the growth of ZnO were explored, and the growth mechanism of ZnO was speculated. The photoelectric synthesis catalytic conditions of the microspheres agglomerated between different sizes of ZnO are explored, and the direct influence of the small dye-sensitized micro-solar synthesis cells currently used in the synthesis on the synthesis of small dye-sensitized micro-solar cells is directly affected. Laboratory research results show that in order to use more reactive dyes for dye adsorption in order to improve the efficiency of the conversion using dye sensitizers and solar fuel cells, the dye film needs to pass through ZnO and be adsorbed by the dye at the same time. The morphological structure should not be too dense and the film should not be too thick; at the same time, the absorption of the dye film should be proportional to the overall coating thickness of the film. Therefore, the overall thickness of the film should be moderate when used in ZnO.

Keywords: ZnO, Dye Sensitization, Photoanode, Solar Cell.

1. Introduction
Globalization, under the rapid economic development of industrial informationization and modern agriculturalization, has also led to a rapid and rapid increase in the energy consumption of major fossil fuel energy sources such as coal and oil, which has led to a serious global energy crisis and major environmental pollution problems [1-2]. To this end, governments and scientific researchers around
the world are actively looking for effective solutions, hoping to replace traditional fossil energy with green, clean, and sustainable energy, while avoiding the further deterioration of environmental pollution [3-4]. Various traditional electronic semiconductor applications represented by ZnO. Semiconductor traditional photocatalytic material technology has failed to efficiently convert natural solar particles into natural hydrogen energy. At the same time, it effectively degrades organic pollutants and becomes the current one of the most popular methods and its important application prospects in the fields of environmental governance and new energy has attracted widespread attention [5-6]. Realizing the efficient and efficient conversion of traditional solar energy to clean electricity is an effective way to effectively solve the global energy crisis and reduce environmental resource pollution [7-8].

Using a simple hydrothermal method at 97°C, ZnO particles grow under different ethanol-water concentrations. The changes in the structure and morphology of the particles are studied by changing the concentration of ethanol. Scanning electron microscope images show that the concentration of ethanol is the main factor affecting the morphology and size of ZnO particles. The X-ray diffractometer spectrum shows that the crystal structure of ZnO particles changes with the concentration of ethanol in the starting solution [9]. During the hydrothermal synthesis process, zinc hydroxide was found in ethanol-rich solution instead of zinc oxide. In the dye-sensitized solar cell, the photovoltaic performance of the synthesized ZnO nanocrystals as a photoanode material was tested [10].

In this paper, through systematic in-depth analysis and discussion, the working principle, structure, working system principle and technical characteristics of the sensitization system are compared, and the technology development trend of the application of solar cells using zinc oxide and silicon dye sensitization and the current status of the technology development and different energy-saving reforms are introduced. Through complex dye surface physical modification and structural changes, the overall photoelectric sensitization performance of a new type of solar cell sensitized by ZnO to a variety of dyes is studied. Starting from the structure-activity relationship between microbiology, structure and longitude, the electron transfer mechanism is analyzed.

2. (Nickel) Substrate Nano-Zno Dye-Sensitized Solar Cell Preparation and Performance Research

2.1 Research Methods
(1) Explore the preparation of ZnO materials with different morphologies using glutamic acid as a configuration agent. Ethyl aminoglutarate is used as the main configuration agent, and the reactants mainly composed of zinc aminoacetate and sodium hydroxide can also undergo high-temperature hydrothermal reaction. The water-soluble concentration of different reactants is changed by heating, and the heating temperature of the reaction is It is possible to prepare ZnO with different configurations and morphologies with continuous reaction time and so on.

(2) Further explore the effects of different amino acids on the growth of ZnO and speculate on the mechanism of the effects of different amino acids on the growth of ZnO. Using amino acids with different isoelectric points as configuration agents to verify the universality of ZnO growth law when amino acids are used as configuration agents. Further study the influence of amino acids with different isoelectric points on the growth of ZnO, and speculate the mechanism of the influence of amino acids with different isoelectric points on the growth of ZnO. Then design related experiments to verify the mechanism.

(3) ZnO is used as a photoanode material for dye-sensitized solar cells to make batteries and study its photoelectric properties. From the prepared ZnO materials, select typical representatives with suitable size and novel morphology, and characterize them.

(4) Various preparation methods are being explored for the production of ZnO and other group polymerized forming spheres with different diameters and sizes, which are widely used in the production of dye sensitizers and photoanodes of solar plastic panels, and photoelectricity is carried
out on them. ZnO agglomerated spheres were prepared according to the reported method, and the change of the size of ZnO agglomerated spheres was studied by changing the amount of polyvinylpyrrolidone added.

2.2 Influencing Factors of Photocatalysis

In order to deeply understand the photocatalytic reaction process, people have done a lot of research on the factors that may affect the photocatalytic efficiency, and have achieved unanimously recognized progress and results.

2.2.1. Band structure. The change width of the forbidden electric band of the conductor and the change of its frequency relative to a certain standard value of the hydrogen ion electrode potential, the change position of the electric band and the valence band, and the number and magnitude of the change will make it catalyze the photoconductor. The size of the optical efficiency has a greater impact. In the entire photocatalytic chemical reaction system, the direct relationship between the potential of the conduction band and the potential of the valence band, the potential of the oxidation bond and the reduction bond, determines the entire photocatalytic reaction efficiency of all semiconductors, that is to say, the potential of the receptor cannot be less than the electric potential of the conductor of all semiconductors, the more the donor's electric potential cannot be greater than the electric potential of the entire valence body of all semiconductors, the more conducive to improving and enhancing the efficiency of photocatalysis.

2.2.2. Grain size. The size of the crystal grains has an important influence on the photocatalytic reaction. Generally, the photocatalytic efficiency of the photocatalyst in the powder state is low. A large number of studies have shown that when the size of a semiconductor material is reduced to the nanometer level, its optical, electrical, thermal, and magnetic properties will change significantly.

2.2.3. Specific surface area. When the intensity of incident light is constant, the yield of photogenerated electron-hole pairs is proportional to the total amount of incident light. For example, the larger the surface area, the larger the electrons will absorb more incident light, generate more photons and produce electron-hole pairs. For example, the larger the light surface area, the more reactive light sites, which also helps to greatly improve the efficiency of the active photocatalytic reaction.

2.3 Optimization of Composite Film Photoanode

In order to better improve the performance of the photoanode, reduce the electron-hole recombination, inhibit the progress of the dark reaction, expand the absorption of ultraviolet and visible light, and then the conversion efficiency of the dye-sensitized solar cell, the composite film can be optimized by the following methods:

1) Metal ion doping: Metal ion doping will enter the crystal lattice of the semiconductor, changing the lattice size, the morphology of the composite film, and the band gap of the photoanode semiconductor. The reduction of the lattice size will increase the specific surface area of the composite film and increase the adsorption of the dye to the composite film; the morphology of the composite film changes, nanowires, nanotubes, etc. provide the shortest orbit for electron transmission, which is conducive to the transmission and collection of electrons.

2) Doping of non-metallic elements: Due to the large number of vacancies and oxygen defects in the composite film photoanode, it is easy to be excited under light, and is easily oxidized by electrolytes and dyes, resulting in poor performance of dye-sensitized solar cells. Doping non-metals in the photoanode can reduce oxygen defects and holes. The use of non-metallic elements for doping is because the size of non-metallic elements is close to that of oxygen, which is easy to fill oxygen defects and will not cause lattice mismatch.
(3) Chemical photoanode overall surface dye treatment: There are two main application methods for chemically modified dye treatment of the anode surface: one is to directly treat the overall surface of the optical solar electrode by using a variety of chemical dye solvents, which can directly make these optical solar electrodes. The overall surface area is greatly increased according to roughness and ratio, so they can adsorb more chemical dyes at the same time. The second is to use multiple oxides to treat the surface of the semiconductor photoanode.

(4) Nanostructured photoanode: Since nanoparticle photoanode is not the most ideal photoanode material for DSSC, its electron transmission efficiency is not high, the specific surface area is not large enough, and the ability to scatter incident light is weak. The semiconductor nanostructured photoanode has become the development trend of dye-sensitized solar cell photoanode in the future.

(5) New type photoanode composite material: In order to better effectively improve the chemical dye sensitization and the conversion efficiency of solar material panels, the composite thin-film photoanode needs to absorb more visible light. Therefore, it is necessary to study the narrow band gap composite film. Among them, the types of multi-element oxide materials are abundant, the physical and chemical properties are easier to adjust, and the semiconductor band gap is also easy to adjust.

2.4 Preparation and Performance Algorithm of Zno Dye-Sensitized Solar Cells
The neutral electrons oxidized by electrons in the electrolyte diffuse to a counter electrode in the supply system, and are reduced by electrons on the outer surface of the counter electrode. The state of each electronic reactant remains unchanged during the entire process of photoelectric conversion reaction. The process of photoelectric particles converting light can generally be expressed by the following equation sub-formula:

\[ \text{D+hv} \rightarrow \text{D'} \]  
\[ \text{D'} \rightarrow \text{D}^+ + e^- \rightarrow E_{cb} \]  
\[ \text{D}^+ + X^- \rightarrow \text{D} + X \]  

Among them, D represents the dye molecule in the ground state, D' represents the dye molecule in the excited state, and D^+ represents the dye molecule in the oxidized state. X represents a halogen molecule, and X^- represents a halogen anion.

\[ V_{oc} = \frac{1}{q(E_f-E_o)} \]  

3. (Nickel) Substrate Nano-Zno Dye-Sensitized Solar Cell Preparation and Performance Experimental Study

3.1 Research Purpose
Compared with other new-type solar energy application battery materials, light-sensitive solar fuel cells mainly have several major advantages such as low technical production cost, simple production process, and environmental friendliness. Its theoretical and high performance in photoelectric thermal energy conversion and utilization, and low actual certification performance disadvantages, poor working stability and short life expectancy hinder its further development. How to improve the photoelectric conversion efficiency and stability of photosensitive solar cells, extend their lifespan and develop photosensitive solar cells based on practical application theory has become an important issue.

3.2 Preparation of ZnO Nanorod Array
ZnO NRAs are prepared by electrochemical deposition. The electrolyte is composed of a mixed solution of 0.02M Zn(2+6O, 0.01M and 0.01M HMT, the solution temperature is 90°C, the deposition time is 50min, and the current density is -2.0 mA cm-2. In the process of electrodeposition of ZnO
NRAs, the FTO conductive glass (1.5cm × 2.5cm) and carbon rods cleaned by ultrasonic cleaning with a mixture of ethanol and acetone were used as the working electrode and the auxiliary electrode, respectively. After the electrodeposition, the FTO substrate on which ZnO NRAs were grown was washed with distilled water several times and dried naturally at room temperature.

4. (Nickel) Substrate Nano-Zno Dye-Sensitized Solar Cell Preparation and Performance Experimental Analysis

Under different NaOH concentrations, the hydrothermal method is used to grow ZnO nanoflowers on the surface of nickel film. Since the morphological diameter of ZnO nanoflowers is larger than the diameter of nickel nanoparticle, ZnO will grow uniformly on the surface of nickel and combine well with nickel.

The influence of nickel/ZnO films prepared with different NaOH concentration ratios on dye absorption is shown in Figure 1 and Figure 2:

![Figure 1. N719 Dye UV-Vis Absorption Spectrum](image1)

![Figure 2. The relationship between dye concentration and light absorption](image2)
It can be seen from Figure 1 and Figure 2 that as the concentration of NaOH increases, the reaction rate gradually improves, and the length of the petals of ZnO-NaOH nanoflowers will also be further expanded. In order to ensure that a larger number of various dyes can be effectively absorbed and used, and at the same time to improve the performance of various dye sensitizers and the dye conversion efficiency of solar cells, the dye must pass through the ZnO and the dye when it is put into use. The appearance and morphology of the dye-adsorbed ZnO film is generally not too dense and the dye-adsorbed coating is generally not too thick; at the same time, the overall absorption dose and quantity of each dye and the overall coating thickness on the dye film It should also be proportional, so the overall thickness of the dye ZnO and the film are relatively moderate.

Table 1. The relationship between N719 dye absorbance and dye concentration

| N719 concentration(mol/L) | Absorbance |
|--------------------------|------------|
| 0.9616×10^{-4}           | 2.117      |
| 1.9231×10^{-4}           | 4.325      |
| 2.8847×10^{-4}           | 6.353      |

It can be seen from Table 1 that the working principle of the numerical test of the chemical absorption of the dye: Whenever the dye is directly irradiated by ultraviolet or visible light, some basic groups of the dye will undergo a transition and the absorbed reflection spectrum is the same as the measured dye. There is a certain proportional relationship between the chemical concentration level.

5. Conclusions

In this paper, the purpose of synthesizing ZnO materials with different morphologies as photoanode materials for dye-sensitized solar cells is to explore the optimal conditions for synthesizing ZnO and the influence of different reaction conditions on the growth of ZnO, so as to infer the growth mechanism of ZnO. The comprehensive application of the two materials and ZnO to various dye sensitizers and solar material cells, and fully explain the important influence of the chemical properties of these materials on improving the photoelectric conversion performance of dye sensitizers in solar material cells. It is concluded that although the interaction change law of amino acids with different potentials on the growth of ZnO molecules has a certain generality, the interaction changes with the isoelectric points of different amino acids and thus shows regular changes. At the same time, the nano-cauliflower-like plastic samples are changed. And the use of ZnO to make nanoplastic particles can be used as a photoanodic material or as a light source to assemble fluorescent dye sensitizers and solar plastic cells and conduct a comprehensive test of their photoelectric sensitization performance. It is found that they have a large specific surface area, the characteristics of better internal connectivity and appropriate size are more suitable for photoanode materials or scattering layer materials. The dye-sensitized solar cells have the best photoelectric conversion efficiency and photocurrent performance.

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