

Application of photocatalytic performance test in undergraduate experimental teaching

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Abstract: with the rapid development of economy and society and the continuous improvement of scientific and technological level, photocatalytic technology has become the latest method of environmental pollution treatment in the new era. It can realize the interpretation and catalysis of organic matter, and has the characteristics of fast reaction speed and low process cost. In undergraduate experimental teaching, teachers carry out experimental teaching with photocatalytic performance test, which is helpful to cultivate students' ability to solve complex problems and form comprehensive thinking ability, so as to help students realize the organic integration of knowledge and ability. Based on this, this paper analyzes and studies the application of photocatalytic performance test in undergraduate experimental teaching, for reference.

Key words: photocatalytic performance test; Undergraduate experimental teaching; Innovation experiment preface

As an important part of higher education, experimental teaching helps to cultivate students' good problem-solving ability, form high-level thinking quality, and help students integrate knowledge and ability organically. The introduction of cutting-edge scientific problems into the course teaching can improve students' interest in learning and increase their professionalism, so as to improve students' comprehensive quality and ability. Therefore, teachers can use photocatalytic technology to carry out teaching, so that students can master the most cutting-edge and simple technology, and learn the basic principle of photocatalytic degradation of pollutants.

1 Principle of photocatalysis

The principle of photocatalysis is based on the oxidation-reduction reaction of photocatalyst under light conditions to purify pollutants and realize the synthesis and transformation of substances. In general, the photocatalytic oxidation reaction uses semiconductors as catalysts to divide organics into carbon dioxide and water by degrading organics. Therefore, photocatalytic technology, as an efficient, safe and environment-friendly technology, has been supported and recognized by the international academic community.

The principle of photocatalysis is to realize the separation of current carrying words through semiconductor materials under light irradiation at a certain wavelength. Among them, the combination of photogenerated electrons and ions can form oxidizing active free radicals, which can realize the explanation of organic macromolecules, so as to realize the efficient degradation of the whole process. The whole process does not involve secondary pollution and has high biodegradability. It is an environmental friendly reaction and can be loved by more people.

In the process of photocatalysis, the utilization rate of solar energy is relatively low, and there will be large energy loss. The main reasons are as follows: first, the light absorption rate of photocatalytic materials is not high. Second, all kinds of defects lead to the recombination of photogenerated electrons and holes. Only the catalyst with high catalytic type can solve the practical problems. At present, scientific researchers mainly carry out research from the aspects of material Nanocrystallization and multi-component compounding, which has a good application prospect in a wide range of fields. Therefore, undergraduate educators should fully study the photocatalytic performance, so as to design the corresponding experiment of photocatalytic performance test, train students to form good experimental skills, improve students' interest in exploration, stimulate students' initiative in learning, scientifically analyze and solve problems, and improve their innovation literacy.

2 Significance of carrying out photocatalytic performance test experiment

1. Deepen students' understanding of theoretical knowledge

The first law of photochemical reaction is reflected in the excited state electrons of photocatalysts under the reaction of light. Only the absorption of light can cause photochemical reaction, and also show the characteristics of material structure. By comparing before and after illumination, students can deepen their understanding of knowledge, understand the characteristics of photochemical reaction thermodynamics, understand the direction of photochemical reaction and ΔG size. Photocatalysis involves photochemical and catalytic reactions, and has special properties and characteristics. The important characteristic of catalytic reaction is to change the chemical balance, so as to produce a reaction. Under the action of light reaction, it can be found that the catalytic reaction that is not accepted in thermodynamics is still feasible, which can stimulate students to form good thinking ability, grasp the relationship between knowledge, and deeply understand the connotation of theoretical knowledge.

2. Enhance students' understanding ability and further study knowledge

Students of chemistry related majors tend to ignore the connection between majors in the learning process. Although chemistry has strong connection with other fields, the knowledge points are relatively difficult to understand. Therefore, carrying out experimental teaching can help students strengthen their understanding of knowledge, learn the significance of photocatalysis through experiments, and lay a solid foundation for the subsequent development of photocatalytic sterilization and photocatalytic anti-tumor. Students can understand the importance of physical chemistry through experiments, so as to more actively participate in the experimental learning classroom.

3 Problems in the existing undergraduate experimental teaching design of photocatalysis

At present, the knowledge of photocatalysis involved in college teaching is not much, and there are almost no pharmaceutical related professional courses. And there are some design problems in photocatalytic experiment teaching. First of all, the experimental content is relatively large, and the experimental requirements are relatively high. At this stage, the content of experimental design is relatively complex, including the characterization of photocatalyst synthesis and the optimization of photocatalytic conditions, but students need to have certain knowledge reserve ability and instrument operation ability. Students are required to analyze the data obtained and teach based on the knowledge reserve of undergraduate students. But the actual teaching content exceeds the requirements of the syllabus. Secondly, the class hours are relatively long. As the experimental design scheme involves relatively more contents and requires more class hours, it will require more than 20 class hours. Normal undergraduate experimental teaching can not meet the learning requirements of students. Thirdly, there is a lack of experimental teaching materials and experimental programs. At present, students majoring in chemistry will encounter more chemical theory and material knowledge in their study. They have high requirements for the use of structural characterization of materials, which do not meet the plan and requirements of pharmaceutical professional training. At present, there is no textbook to support the experimental teaching, and there is no experimental content related to photocatalysis.

4 Experimental design of photocatalytic performance test

1. Sample selection

Selection of this study -As the main research object, Bi₂MoO₆ is a kind of bismuth based photocatalyst, which can produce obvious absorption effect in the range of visible light. It is an important structural system in the field of photocatalysis. Among them, it has the simplest layered structure characteristics. It can form a unique layered calcium titanate. This structure is conducive to the transfer of photocarriers. It can also realize the role of photocatalytic performance through the change of molecules and ions between layers. In addition, there is also obvious light absorption effect in the range of visible light, which can realize the catalytic activity of potential visible light.

2. Preparation

The preparation process is relatively complex. It should select samples scientifically according to the preparation conditions, so that students can understand how to prepare raw materials and how to determine the appropriate reaction temperature and pH. By answering the above questions, students can deeply understand the knowledge and principles contained in the preparation process. γ -Bi₂MoO₆ is synthesized by hydrothermal method. In the first step, an appropriate amount of bismuth nitrate is dissolved in ethylene glycol solution, and stirred to a completely dissolved state after 30 minutes of magnetic stirring. Add sodium molybdate into deionized water to make sodium molybdate solution. After 30 minutes of magnetic stirring, add the sodium molybdate solution into bismuth nitrate solution to form a mixed solution. Adjust the pH value of the solution with sodium hydroxide to make it reach the standard of 7. Finally, polyvinylpyrrolidone was added for stirring to ensure that the stirring time was controlled within 30 minutes. Put the above precursor solution under high temperature and high pressure, and keep it at a constant temperature of 160 °C for 12 hours. After cooling to room temperature, take out the sample, pour it into the clear liquid, and wash it repeatedly with alcohol and deionized water. Finally, the dried product at 80 °C is obtained.

3. Catalytic performance test

In order to let students deeply understand the phenomenon and principle of the experiment and master the performance test method of photocatalysis, teachers guide students to observe under irradiation -Change characteristics of Bi₂MoO₆ substances, and understand and explain the photocatalytic performance of rhodamine. The specific experiments are as follows: 100 ml of rhodamine aqueous solution with a concentration of 10mg/l was mixed with 50mg of photocatalyst. Then, the mixed solution was placed in a dark room and stirred for 20min, so as to achieve an equilibrium state of solution adsorption. Finally, turn on the light of the light source, control the irradiation time, ensure that about 4ml of solution is extracted every five minutes, take out the clear liquid by high-speed centrifugation, and test it with the UV-Vis spectrophotometer, so as to adjust the concentration calculated by the curve.

5 Experimental teaching strategy of photocatalytic performance test

1. Clarify the experimental principle and overall conception

As an extension of theoretical teaching, experiment is the basis of experimental teaching. The experimental principle is the basis of the experiment. Photocatalysis involves photochemistry, catalysis and so on, which belongs to the chapter of chemical kinetics. Therefore, teachers should clarify the main requirements of photocatalytic content before teaching, so as to understand the kinetic model and reaction rate equation. Photocatalysis converts light energy into chemical energy and realizes photochemical and catalytic reactions. Before practical teaching, teachers should analyze the basic principles of photochemical reactions, optimize the overall thinking based on the clear basic principles, realize the explanation of organic matter, avoid secondary pollution, and use photocatalysis technology for better sewage treatment, Degradation of drug residues and other substances. Strong oxidizing substances can play an antibacterial role.

2. Scientific analysis of catalytic performance

Teachers should guide students to observe the color of RHB during the test, record the peak value of UV-Vis absorption spectrum, and then determine the degradation rate under light irradiation according to the peak value of absorption spectrum. With the increasing of illumination time, the dye solution also fades, and the peak value gradually decreases at 663nm. Next, the teacher guided the students to draw a diagram of catalytic degradation efficiency. The numerical value represents the process of rhodamine adsorption equilibrium under light. The change of light concentration after rhodamine adsorption was analyzed. The actual situation of sample degradation was understood

by analyzing the catalytic performance. After completing the above catalytic performance test, the teacher should guide students to build a systematic catalytic performance. Photogenerated electrons will analyze the reaction of oxygen adsorbed on the surface of the photocatalyst to produce strong oxidation, and finally form water and carbon dioxide.

3. Optimizing teaching evaluation methods

The teaching evaluation at the end of the experiment is helpful to analyze and understand the students' learning effect, understand the students' understanding of the principle of photocatalysis, and build a perfect catalytic reaction effect through the operation of catalytic instrument and catalytic performance test. In addition, students can link theory with time in the process of learning, guide students to master the basic principle of photocatalysis, analyze the basic operation together, so as to draw the time change curve of photocatalytic degradation rate and make basic analysis. However, due to the influence of many factors on the catalytic performance, students' learning time is relatively limited, and there is no way to complete the test. Therefore, in the follow-up teaching, teachers can allow students to enter the instructor's research group in advance, so as to prepare samples and improve students' understanding of catalytic materials. In the teaching evaluation stage, teachers should evaluate students' operation, group cooperation and knowledge mastery, so as to carry out comprehensive evaluation on students and strengthen students' understanding of catalytic materials.

epilogue

To sum up, photocatalysis is the use of light energy to excite a certain type of material, so that the electrons in the material can produce a transition, and the active molecules can be obtained through a series of reactions, playing a good catalytic role. In professional teaching, teachers should optimize the design of photocatalysis experiment, according to the specific characteristics of the specialty, according to the teaching plan and syllabus, taking into account the specific characteristics of undergraduate experimental teaching, analyze the factors such as experimental equipment and teaching hours, and make full use of advanced educational concepts and means in the process of teaching implementation to mobilize students' learning enthusiasm, Improve students' innovative literacy.

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