International Journal of New Developments in Engineering and Society
ISSN 2522-3488 Vol. 4, Issue 2: 55-59, DOI: 10.25236/IJNDES.040211

# Preparation and Application of Electrocatalytic Electrode Materials in Wastewater Treatment

**Jinfeng Sun[1], Kun Quan[2], Yongqiang Meng[1]**

*1 Key Lab of Material Near Net Forming Technology of Hebei Provice, Shijiazhuang, Hebei, China;2.College of Materials Science and Engineering, Hebei University of Science and Technology, Shijiazhuang 050018, China*
*2 Polythechnic College of Hebei University of Science and Technology, Shijiazhuang 050018, China*

***ABSTRACT.*** *As a green process, electrochemical wastewater treatment technology has unique advantages in the treatment of organic wastewater, so it has been favored by researchers at home and abroad in recent years. In the electrochemical reaction system, the electrode is in the "heart" position, which is the key factor to realize the electrochemical reaction, improve the current efficiency and reduce the energy consumption. Therefore, it is of great practical significance to find and develop electrode materials with high catalytic activity.*

***KEYWORDS:*** *Sewage treatment, Electrocatalytic electrode material, Preparation, Application*

## 1. Introduction

With the rapid development of society and economy, there are a series of environmental problems. Human beings are suffering from the threat and harm of serious environmental problems. In many environmental problems, water resources are the focus of attention. Due to the discharge of a large number of toxic and harmful pollutants, the water shortage has caused pollution. The water crisis has become a common problem for all mankind. All countries in the world are increasing their efforts in the research of rational utilization of water resources and water pollution control technology to ensure the basic water demand for economic development and people's survival. China is one of the countries with the most serious environmental pollution in the world. The daily discharge of sewage is more than 100 million tons, of which more than 80% is directly discharged into the water area without any treatment. Through the monitoring of 532 rivers, 436 rivers have suffered different degrees of pollution. Of the 15 major cities that 7 major rivers pass through, 13 of them are seriously polluted. As a result of a large number of pollutants discharged into rivers, lakes and seas, the water environment in China has

ISSN 2522-3488 Vol. 4, Issue 2: 55-59, DOI: 10.25236/IJNDES.040211

suffered serious pollution and damage. It is estimated that the resulting economic loss is more than 200 billion yuan per year. How to control environmental pollution and improve environmental quality at the same time of rapid economic development, so as to achieve the goal of social and economic sustainability, is an important problem to be solved [1].

## 2. Organic Pollutants

The main substance causing water pollution is organic pollutants. The organic pollutants in wastewater can be generally divided into two categories: biodegradable organics and refractory or non biodegradable organics. Biodegradable organics are usually removed by the traditional biochemical method, that is, through the metabolism of microorganisms, the dissolved and colloidal organic pollutants in the wastewater are transformed into stable harmless substances. This technology is widely used for its economy and high treatment efficiency [2].

## 3. The Disadvantages of Current Biological Treatment Technology

As the most widely used biological treatment technology, there are always two disadvantages. One is to produce a large number of excess sludge and aerobic treatment aeration to increase energy consumption. The amount of excess sludge produced by traditional activated sludge process is generally 0.3% - 0.5% of the wastewater volume (calculated by water content of 97%), which is quite amazing. With the population expansion and industrial development, the increasing amount of excess sludge in wastewater treatment has posed a huge challenge to environmental protection workers. The excess sludge contains a lot of harmful substances. In order to avoid secondary pollution, it must be treated strictly. The treatment cost accounts for about 25% - 65% of the operation cost of the wastewater treatment plant, which constitutes a heavy burden on the operation of the wastewater treatment plant, increasing the treatment cost and Engineering investment of the water plant. In addition, the water plant guarantees the oxygen consumed by the aerobic treatment through aeration, which also increases the treatment of wastewater Cost. Therefore, it is of great practical value to develop new treatment technologies to reduce or not produce excess sludge, reduce power consumption and reduce the cost of wastewater treatment. Second, it is not suitable for the removal of difficult biodegradation and biological toxic pollutants. Biological treatment has a high removal rate of biodegradable organics, but with the continuous development of industry, the types and emissions of industrial wastewater are increasing, and the composition is more complex, which contains many phenol, alkylbenzenesulfonic acid, chlorophenol, pesticide, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, dyes and other refractory organics, which are often toxic and harmful “three causes” Carcinogenic, teratogenic, mutagenic substances, their emissions will cause great harm to the environment and human beings, it is difficult to meet the treatment requirements of biological treatment of these substances[3].

ISSN 2522-3488 Vol. 4, Issue 2: 55-59, DOI: 10.25236/IJNDES.040211

## 4. Methods of Environmental Pollution Control

With the composition of wastewater becoming more and more complex, the traditional pollution control technology and means alone in the treatment of environmental pollution can not meet the requirements of the speed of pollutant production and the quality of living environment brought by the progress of human science and technology, and the existing technology must be constantly improved or new ways must be developed. In order to adapt to the characteristics of water quality changes, it is always a new topic to study more economical and effective water treatment methods. In recent years, the electrochemical water treatment technology, which has incomparable advantages with other treatment methods, has attracted great attention of researchers. There are two most attractive electrochemical water treatment technologies, one is the electrocatalytic oxidation method for the treatment of refractory organics, the other is the biofuel cell technology mainly used for the treatment of biodegradable organic wastewater and synchronous bioelectricity [4].

## 5. Preparation of Electrode

### *5.1 Pretreatment of Matrix*

The surface pretreatment of Qin substrate is mainly to remove the organic matters and other oxides attached to the surface of Qin substrate. At the same time, the surface of Qin substrate is etched into uneven and fresh rough surface to increase the real surface area of Qin substrate. In this way, the binding force between the active coating and the substrate is strengthened, the mechanical bond degree is improved, and the service life of the coating is extended. Pretreatment includes three steps: grinding, alkali washing and acid etching. 1) grinding. The qinban is polished with 100 mesh and 600 mesh sandpaper to make the rough metal surface flat and smooth. 2) alkali washing. Place the polished qinban in 40% NaOH for chemical degreasing with alkaline solution, wash it for 30 minutes at 80℃- 90℃, and remove the oil stain. 3) acid etching. The purpose of acid treatment is to enhance the bonding force between the substrate and the metal oxide coating, so as to improve the conductivity and prolong the service life of the electrode. In the experiment, oxalic acid was used to treat the alkali washed chin matrix, and the chin plate was immersed in oxalic acid solution at 85℃for 2 h. After acid etching, the surface of the substrate is uneven and has a large surface area, which improves the electrochemical performance of the electrode. After the acid treatment, a large amount of water should be used to wash the residual oxalic acid and oxalate chin on the surface of the substrate [5].

### *5.2 Electrode Preparation Process*

The common methods of preparing oxide electrode are high temperature decomposition and electrodeposition. At present, some new technologies have also

ISSN 2522-3488 Vol. 4, Issue 2: 55-59, DOI: 10.25236/IJNDES.040211

been applied to the preparation of electrodes, such as spray pyrolysis, rapid deposition and ion sputtering, but relatively speaking, these methods have higher requirements for instruments and equipment. Because of the different experimental conditions and parameter settings, it is difficult to make an overall evaluation of the advantages and disadvantages of various preparation processes at the same time. The performance of electrode material is not only related to the choice of electrode coating material, but also closely related to the electrode preparation process. In this study, modified β - PbO2 / Ti was prepared by electrodeposition. There are many factors that affect the performance of electrodeposition, such as the temperature, composition, pH, current density and time of electrodeposition. This paper mainly discusses the following points: ① the current density affects the crystal shape of PbO2 when it is electrodeposited with current density. Therefore, the suitable current density should be controlled to obtain β - PbO2 with superior performance. ② different electrodeposition time corresponds to different thickness of PbO2 layer. In this study, the electrodeposition time is controlled to 2 h to make active coating with appropriate thickness. ③ generally speaking, the pH value of PbO2 can only deposit α crystal form in alkaline condition, and it is mostly knife crystal form in acid condition. Therefore, nitric acid is used to adjust the pH value in this experiment, and PbO2 of knife crystal form can be electrodeposited in acid condition. (4) determination of additives Zhang Zhaoxian thought that in order to eliminate the stress of anode coating, when plating β - PbO2 layer, the overpotential of oxygen can be increased by adding fluoride, and the formation rate of PbO2 on the electrode surface can be reduced, so as to reduce the internal stress of the coating and make the coating uniform. NaF of about 40 mmol / l was added into the plating solution [6-7].

In order to obtain β - PbO2 / Ti electrode with good catalytic performance, uniform surface density and strong binding force, and β - PbO2 / Ti electrode modified by doping iron series elements, the bath formula and operation conditions for the preparation of oxide electrode by electrodeposition method were determined after repeated tests. 1) preparation of β - PbO2 / Ti electrode. The bath formulations were 0.35mol/l Pb (NO3) 2, 0.1mol/l HNO3 and 40mmol / L NaF. The process conditions were as follows: current density I = 14mA / cm2, copper plate as cathode, stirring, electrodeposition time 2h, the surface of PbO2 / Ti electrode was uniform and compact. 2) preparation of Fe, Co, Ni doped PbO2 / Ti electrode. The bath formulation is 0.35mol/lpb (NO3) 2, 0.1mol/l HNO3, 40mmol / L NaF, Fe (NO3) 3 0.025-0.10mol/l or CO (NO3) 2 0.025mol/l, or Ni (NO3) 2 0.025mol/l. The current density is I = 14mA / cm2, the copper plate is used as cathode, stirring, electrodeposition time is 2H, and the doped PbO2 / Ti electrode is prepared [8].

**Acknowledgement**

Research of preparation of graphene/TiC nanocomposite electrode by reactive ball milling and its electrocatalytic performance, The research project of science and technology in Colleges and universities of Hebei Province (QN2017069).

ISSN 2522-3488 Vol. 4, Issue 2: 55-59, DOI: 10.25236/IJNDES.040211

**References**

[1] Liu Yanbiao (2011). Photocatalytic degradation of organic pollutants and comprehensive utilization of chemical energy of pollutants by new electrode materials [D]. Shanghai: Shanghai Jiaotong University.
[2] Zhang Yaping (2017). Study on Ag / RGO / BiVO4 membrane cathode system assisted by biological anode and water treatment [D]. Liaoning: Dalian University of technology.
[3] Yang Shengxiang (2017). Study on the mechanism of catalytic reduction of NO3 - by copper zinc cathode [D]. Jiangsu: China University of mining and technology.
[4] Yu Shiyi (2017). Study on the preparation and performance of silicon quantum dots and SnO2 protected silicon nanowire photovoltaics [D]. Liaoning: Dalian University of technology.
[5] Wang Gang (2017). Preparation of graphene-wo3 / TiO2 nanotube array photoelectrode and photocatalytic degradation of dimethyl phthalate in water [D]. Shandong: Qingdao Agricultural University.
[6] Ouyang Xuemei (2016). Study on modification and degradation of organic wastewater by Ti / TiO2 NT / PbO2 electrode [D]. Anhui: Anhui University of technology.
[7] Chen Yali (2015). Electrocatalytic reduction of organic pollutants by modified electrode based on electrodeposition of copper [D]. Anhui: China University of science and technology.
[8] Liu Xiaocheng, Wei Jianhong, Zhou yaoyu, et al (2018). Research progress in electrochemical degradation of wastewater by modified carbon cathode [J]. Contemporary chemical industry, vol.47, no.3, pp. 625-627-631.