Research on Environmentally Friendly Chemical Technology for Green Reusable and Sustainable Water Metal Copper Ions

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Abstract. In traditional chemical processes, they are considered highly polluting and unfriendly to the environment. The air, water, soil, and land were severely damaged. Among the international environmental protection issues, especially the development of industry is a very worthwhile study. Therefore, this study will discuss metal ions in water. This study takes copper as the object of discussion. In the future, different metals, such as nickel, iron, zinc, and other metals, will be discussed, and industrial process problems will be solved. For copper, it is also a common metal in life. Copper metal bottles, handicrafts, circuit boards, heat dissipation components, metal soldering agents, sewage treatment agents and many other uses. However, in the copper process, electroplating, and waste after use are often treated as secondary pollution. From the perspective of technology and process, an environmentally friendly chemical process is proposed, which can also make the best use of reactants and waste water. After the process improvement, the copper ions are post-processed to extract new copper compound material technology. At the same time, the water body is controlled at pH 7, which can be reused more to achieve the goal of sustainable circulation.

Key words. Copper ion; material; reuse; chemical process; environmental protection.

1. Introduction

The fat component during scrap recycling cannot be immediately evaporated, this condition causes pollution. The Institute of Scrap Recycling Industries indicated that nonferrous scrap comprised less than 10% of the total recycled material in the US in 2011 and more than 50% in 2012. More than 9
million metric tons of nonferrous scrap was processed in the United States in 2011.

Prices of PE film scrap have increased in Germany, along with prices of waste polyethylene film in August 2014. The higher price of film scrap could not be passed on as re-granulate price. Shanghai Metals Market denoted that based on the latest statistics provided by the German Steel Recycling Federation (BDSV), scrap prices in the country continued to drop further in July 2015. And prices of old scrap decreased to €184 per ton. Shredded scrap prices decreased to €208 per ton in July 2015, and prices of new arising’s reached €202 per ton. Meanwhile, many researchers have studied the characteristics and performance of batteries. The main purpose is for saving the green planet and increasing the innovation.

Developed long-term cycle life and high yield electrodes [1]. A three-dimensional layered nano porous $\alpha$ - Fe$_2$O$_3$ film was prepared, which can be applied to the anode of Li-Fe battery without binder. The strategy of increasing the anode limit capacitance of Fe$_2$O$_3$ is put forward. The energy density of 0.89 MWh cm$^{-3}$ can be obtained by using asymmetric super capacitor with high voltage and doping titanium polymer coating [2]. The voltage of lifeso 4F is higher than LiFePO$_4$. In the past research, studied the recycling of waste magnetic pole pieces as ferrous anode materials [3]. This technology can include chemical purification process saving and calcination gas reflux. On the other hand, the team also used waste metal recovery technology to make cathode materials [4].

Studied the in-situ HRTEM observation of electrochemical lithium of FePO$_4$ in an all solid state electrochemical cell device [5]. The device is composed of FePO$_4$ crystal working electrode, Li$_2$O solid electrolyte growing naturally and massive lithium metal pair electrode. The orthogonal crystal FePO$_4$ was obtained by chemical lithium removal reaction of LiFePO$_4$ synthesized by hydrothermal method. Showed through density-functional theory calculation that co-doping with Si on the P-site and F on the O-site modifies the nature of the conduction band edge of LiFePO$_4$ from localized Fe three-dimensional derived states to more delocalized F’s and cation s-derived states [6]. Comparative doping experiments mainly show that the electrical conductivity of Si P-FO co-doped with LiFePO4 exhibits an increase in electrical conductivity by least 2 to 3 orders of magnitude compared to that of undoped LiFePO4. Showed that conflicting demands on Li-ion electrodes, combining high ionic conductivity with high electrode density, are achieved by hydrogen carbonate salt templates creating three-dimensional highly interconnected ionic pathways [7]. This exceptionally simple and cheap template method results in electrodes with excellent high-rate capacity retention and very high electrode densities reaching $\sim 2$ gcm$^{-3}$.

The basic copper carbonate precursor was prepared by simple hydrothermal method, and the porous CuO structure with layered structure was successfully prepared [8]. After the precursor is transformed into porous CuO structure by sintering, the shape of the precursor can be preserved. The specific surface area of CuO is 12.0 m$^2$/g, and the pore size is about 30 nm.

Showed due to electrolysis hydrogen when the negative-hydrogen will corrode the substrate copper, resulting in copper dilute, and thus affect the performance of electrolytic hydrogen production [9]. Showed the recycling rate of lithium plate reached 80%, and the process was as follows: decomposition $\rightarrow$ acid dissolution$\rightarrow$filtration$\rightarrow$purification (pH 2 to pH 3) and blending [10-12]. This process produced waste liquid with a pH of 5~7. The recycled control materials were attached to the original material. Internal reduction and calcination were performed to remove moisture during crystallization at 450 °C, as shown in figure 1. Number 1 was scrap, number 2 was divalent iron phosphate oxide with 4 water of crystallization, and number 3 was divalent iron phosphate oxide with 2 water of crystallization.

In this study, the environmental protection chemical technology of green reusable and sustainable metal ions was studied. This method uses chemical methods to stabilize the internal reaction in order to balance the reactants without heating. By using the pressure difference of three-dimensional input pressure rotation, a three-dimensional flow field is formed, which can prevent stratified flow and stabilize the internal flow. In order to solve the problem of traditional synthesis, the chemical technology of metal copper ion, which is green, renewable and sustainable, is studied will improve it in the future for electroplating copper and its waste liquid, reducing metal copper compounds.
2. Experimental Design and Principle
In terms of environmental protection and reusability, copper ion chemical technology was studied. Use innovative three-dimensional hybrid technology for recycling. The waste liquid in copper processing is often treated as heavy metal waste liquid. From the point of view of process, an environmental protection chemical process which can make full use of both reactants and waste water is put forward. The three-dimensional flow field with forced convection formed by the up and down flow is shown in figure 2. This design can overcome the viscous force of viscous fluid and make the reaction sink mix evenly. The gas in the reaction can be recycled, and the water produced after recovery and filtration can be reused in the reaction sink. The advantages of this design include shortening the reaction time, reducing the production cost and enlarging the parameter change after the process.

![Figure 1. Scrap recycling results (FePO4· nH2O) [10].](image)

![Figure 2. Three dimensional mixed fluid barrel for metal copper Ions recycling.](image)

The purpose of this study is to recycle the waste liquid produced in the process of copper compound processing. To solve the problem of concentration and separation of low-concentration copper ionic liquid in liquid circulation, it is divided into two parts: 1. The pH value of copper ion was controlled
between 3-8, then the copper compounds were separated, dried to form Cu\textsubscript{x}(OH)\textsubscript{y}\cdot Cu\textsubscript{x}CO\textsubscript{3} or Cu\textsubscript{x}(OH)\textsubscript{y} or CuO and other related compound powders. Finally, samples were sent for analysis by SEM and ICP. 2. After the water is concentrated and separated, the RO or filter water is added into the circulating sink. At the same time, the water body is controlled at pH 7, which can be reused more to achieve the goal of sustainable circulation. The experiment process is shown in figure 3.

Figure 3. Experiment process.

3. Results and Discussion
Copper ions in water body include copper plating solution and surface copper washed by water. Take the structure of Cu\textsubscript{2}(OH)\textsubscript{2}CO\textsubscript{3} from the reaction formula of Cu\textsuperscript{+} to the theoretical Cu\textsubscript{2}(OH)\textsubscript{2}CO\textsubscript{3} for sample preservation. In the future, the powder will be transformed into Cu\textsubscript{x}O\textsubscript{y} or Cu\textsubscript{x}(OH)\textsubscript{y} or Cu\textsubscript{x}M\textsubscript{y}O\textsubscript{z} or high-purity Cu metal. When NaOH, Na\textsubscript{2}CO\textsubscript{3} and CO\textsubscript{3} were added with different proportions of Cu\textsuperscript{+} H2O, the theoretical value of 1:1.7 and copper content of 57% Cu\textsubscript{2}(OH)\textsubscript{2}CO\textsubscript{3} were produced, showing mint green to yellow green powder. In this study, PH adjustment range of basic reaction, finished product drawing, ICP analysis and SEM analysis of copper ion content adjustment were discussed.

3.1. pH Adjustment Range of Basic Reaction
According to pH interval analysis of acid solution with different copper ion concentration, as shown in figure 4, when pH value is adjusted to 7-7.5, the concentration of copper ion in acid solution is between 10-13.5%, the less reaction solution is added, and the content ratio of reaction Cu compound is < 1.7 theoretical value; when the concentration of copper ion in acid solution is between 3-3.5%, the more reaction solution is needed. The content ratio of Cu compounds in the reaction is ≥ the theoretical value of 1.7.

3.2. Finished Product Drawing
The samples synthesized in this study are shown in table 1 below. Under the reaction synthesis of different copper ion concentrations, the reaction product powder with the concentration of 10-13.5% of copper ion liquid analyzed by ICP is yellow green powder, and then the product powder with the concentration of 3-3.5% of copper ion liquid diluted to 3-3.5% of copper ion liquid is mint green to light blue. The compound Cu\textsuperscript{+} content generated is also balanced due to the reaction of copper ion with alkali Oh\textsuperscript{-}. The change of the state in the charge ion results in different structure, which leads to different color characteristics.
Figure 4. pH test of copper ion content adjustment.

Table 1. Sample table of reaction synthesis under different concentration of copper ion.

| Sample | Copper ion content is 10~13.5% | Copper ion content is 3~3.5% |
|--------|--------------------------------|-------------------------------|
|        |                                |                               |

3.3. SEM Analysis Instructions

From the SEM analysis, we can see that under 20000 magnification, the differences between the structures of the copper ion compounds generated by different copper ion concentrations are shown in table 2. The product structure of sample A with copper ion concentration of 10-13.5% is < 100nm spherical form, and compared with the copper ion compounds with sample B concentration of 3-3.5%, copper compound particle size sample A > sample B under the same magnification SEM. Because of the different concentration of copper ions, the size of the powder is also different.

Table 2. SEM comparison of copper compounds produced by different concentrations of copper ions.
4. Conclusion

Through this experiment recovery technology, to solve the problem of high and low concentration copper solution, the sources of future treatment copper solution include: copper electroplating solution, copper surface acid wash solution, copper solution and other synthesis technologies, which can also achieve the future synthesis of new copper compounds, copper oxides and copper metal materials, and also solve the problem of high cost-effectiveness of copper treatment below 4%. From this technology, we can get nano Meter grade Cu$_2$(OH)$_2$CO$_3$ powder precursor, which also solves the reuse of air pollution and water pollution.

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