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Application of Cast Steel and Carbon Nanotube Composites in Small Agricultural Machinery Castings

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Abstract: Carbon nanotubes are, under certain circumstances, a coaxial hollow tube-shaped nanoscale material because many carbon atoms converge in one place, with a vertical dimension of the order of nanometers and a lateral dimension of the order of micrometers. Carbon nanotube is one of the carbon isotope isomers, and it is also widely used in many aspects. This paper aims to investigate and analyze the application of cast steel and carbon nanocomposites in small agricultural machinery castings. In this paper, the structure, properties and preparation methods of carbon nanotubes are briefly introduced, and then the development of agricultural machinery in China is qualitatively analyzed. First, an experiment of cast steel and carbon nanotube composite materials is carried out, and then the threshold model is used to analyze the data on mechanization levels. The experimental results showed that when cast steel and carbon nanotube composite castings are used, the productivity of small agricultural machinery castings is clearly higher, and the level of agricultural mechanization has also been significantly improved. The total power of agricultural machinery, the power of large and medium-sized agricultural machinery, and the power of small agricultural machinery all have a significant single threshold effect on the proportion of grain-sown area, and the estimated threshold values are 5.641, 3.645 and 2.756, respectively.

1. Introduction

Recently, with the rapid development of scientific research and technology, carbon nanotube composites have become a research hotspot for scholars since their excellent physical and chemical properties and mechanical properties. Scholars mainly study carbon nanotubes and metal materials such as copper, aluminum, magnesium, lead, and zinc by using powder metallurgy methods and mechanical alloying methods. According to the verification of relevant materials, carbon nanotubes have been discovered for more than 20 years. Because of its unique structure, superior rational characteristics, mass availability at low cost, controllable electron affinity, and excellent thermal stability, it has been widely used in various related industries. Especially in the 21st century, it can be found that cast steel and carbon nanotube composite materials are also widely used in small agricultural machinery castings.

Today, when carbon nanotube materials are widely used and developed, scholars have studied many problems in the preparation, characterization, and performance of carbon nanotechnology. This paper is to study the application of cast steel and carbon nanotube composite materials in small agricultural machinery castings, which has further analysis for the study of carbon nanotube composite materials, and has far-reaching significance for the future development of small agricultural machinery. In recent years, some scholars have applied carbon nanotube composites to the research in the medical field, but relatively few applications and researches in the field of small agricultural machinery. Therefore, in this paper, the application of cast steel and carbon nanocomposite materials to the research of small agricultural machinery castings has both theoretical and practical significance. The innovation of this paper included (1) the application of cast steel and carbon nanotube composites in small agricultural machinery castings. In other research reports, carbon nanotube composites have only been studied in its preparation, properties, and other aspects, but this paper studies its application in small agricultural machinery castings, which is equivalent to a new breakthrough. (2) The application of carbon nanotube composites in small agricultural machinery castings is evaluated through the research.

2. Related Work

Due to the special spatial structure and excellent electrical properties of carbon nanotubes, carbon nanotubes have become a research hotspot in recent years. Carbon nanotubes have been widely used in materials, biosensing, catalysis, energy, and many other fields. Among them, L showed in his study that when the S/C ratio is 3, more than 80% of the deposited carbon is self-growing carbon nanotubes (CNTs) with an average diameter of about 15 nm. He found the mechanism of the effect of different types of carbon deposits on the performance of Ni/α-Al 2o3 catalysts on the activity of toluene steam reforming for hydrogen production at different vapor -to-carbon ratios (S/C) [1]. Whereas the data available for his research was too small, resulting in an incomplete article. Zhang S later discovered that carbon nanotubes could be used as an alternative material for "millivolt switches", which were as fast as silicon and generated much less heat [2]. However, this study did not make relevant alternative survey research, but only made an assumption, which has not been applied to reality. Following this, Pint C L introduced a novel method to grow dense arrays of single-walled carbon nanotubes directly on the interface of carbon materials or carbon fibers. This growth process combined the concepts of SWNT tip growth and alumina-supported SWNT base growth [3]. Nevertheless, the scope of his research was too broad to be precise for a detailed study. During the same year, Zhou J synthesized a new type of catalyst by microwave-assisted method, which improved the catalytic activity and enabled the nanoassembled structure to have good catalytic activity [4]. Nonetheless, the model used in this study is not the most suitable one, resulting in inaccurate data. Based on the research summary above, Zaporotskova IV reviewed recent research progress on carbon nanotube gas and electrochemical biosensors. Experimental and theoretical data on the working principle of nanotubes were presented. By analyzing the mechanism of the interaction between carbon nanotubes and functional groups (including carboxyl and amino groups), the structure, energy parameters, and main laws of sensor performance of the modified semiconductor system based on carbon nanotubes were studied [5]. However, his research lacks innovative research on carbon nanotubes, which is relatively common and lacks personal characteristics. On this basis, Yao X used ultrasonic-assisted electrophoretic deposition (EPD) technology to study the effect of carbon nanotube (CNT) coating on the interfacial properties of carbon fiber (CF)/epoxy (EP) composites [6], whereas the literature used in his paper was not novel enough and the article lacked progress. Later, Han X investigated a new type of inorganic nanocarbon coupled homogeneous NiCo 2s nanocrystals and immobilized this type of nanocrystals on nitrogen-doped carbon nanotubes (NiCo 2s/N-CNT) as an efficient bifunctional catalyst for the slow ORR and OER kinetics of advanced rechargeable Zn-air batteries [7]. However, the scope of his research was small and lacked justification for real-world application.

3. Application of Carbon Nanotubes in Small Agricultural Machinery Castings

3.1. Structure, Properties and Preparation of Carbon Nanotubes

(1) Structure of carbon nanotubes

The one-dimensional structure of carbon nanotubes can be regarded as a one-dimensional material obtained by rolling a single layer, several layers, or dozens of layers of a two-dimensional material. Carbon nanotubes have various allotropes, such as zero-dimensional fullerenes and two-dimensional graphene. The structural relationship between the two, as shown in Figure 1, is based on two-dimensional graphene materials[8].

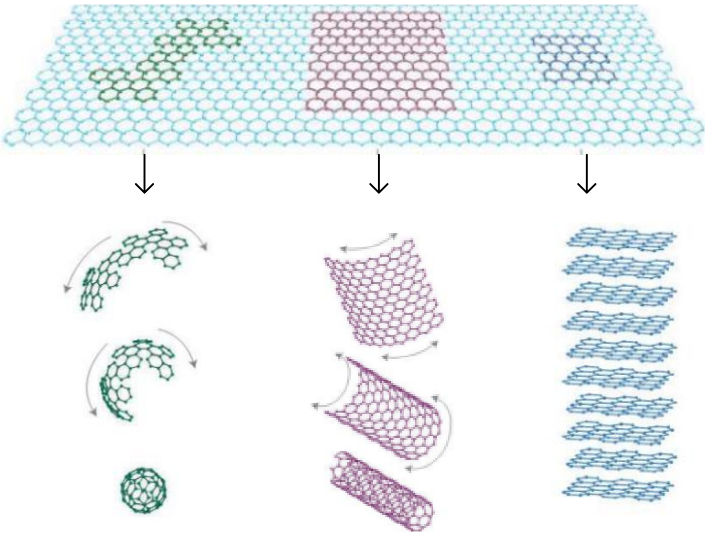


Figure 1: Carbon nanotube structure diagram.

(2) Properties of carbon nanotubes

The special structure of carbon nanotubes shows that they can exhibit many excellent properties that are completely different from macroscopic materials, such as excellent physical and chemical properties, unique electrical properties, special magnetic properties, and strong adsorption properties.

First, carbon nanotubes have excellent mechanical properties under the pressure of 1 million atmospheres; carbon nanotubes will not rupture [9]. Experiments showed that the Young's modulus of single-walled carbon nanotubes can be as high as about one hundred times that of steel, and its value is greater than 1TPa.

Second, according to the analysis of the movement of electrons in carbon nanotubes, the movement of electrons contains directionality, showing a typical quantum confinement effect.

Finally, carbon nanotubes have special magnetic properties, excellent adsorption properties, very special light properties, and excellent thermodynamic properties and information storage properties. It has a very high application value in various industries [10].

(3) Preparation of Carbon Nanotubes

1) Arc discharge method

The arc discharge method can produce large amounts of fullerenes, and carbon nanotubes can be found when carbon fibers are produced using this method. The schematic diagram of the arc discharge method is shown in Figure 2, and its specific process is as follows: The graphite electrode is put in a reaction vessel containing a lot of inert gas (He or Ar), maintain the distance between the two electrodes at 1mm, and apply a voltage of about 20V to make the current from 50 to 100A, so that between the two electrodes the arc will be excited, and the arc temperature will reach 3000C. In this case, graphite evaporates into various forms, such as fullerenes (C6o), amorphous carbon, and carbon nanotubes [11].

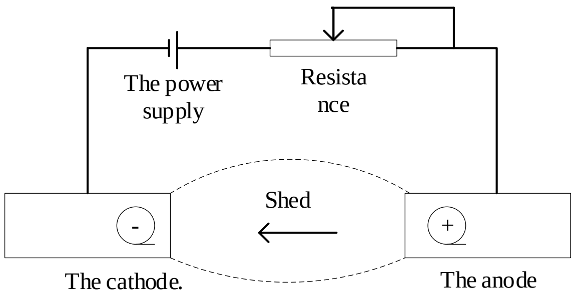


Figure 2: Schematic diagram of arc discharge device.

The electric double layer capacitors are composed of carbon nanotube materials with different thicknesses. Its capacitance, current, etc. have the following relationship:

$$w = v * b \tag{1}$$

$$\text{Thus } u * fy = v * b \tag{2}$$

$$u = v * fb/fy \tag{3}$$

Therefore, the capacity formula can be obtained:

$$vn = 2\frac{\delta_{F^2}^{F^1} fb}{ndb} \tag{4}$$

Finally, the calculation can be obtained:

$$v = \frac{u\Delta y}{n\Delta b} \tag{5}$$

$$I(C) = L_1 C + L_2 \sqrt[2]{I} \tag{6}$$

2) Laser ablation method

The laser ablation method is shown in Figure 3, and its process is: A graphite target mixed with metal catalyst and graphite is placed in the middle of the quartz tube in the heating furnace. When the furnace temperature reaches the required temperature, the inert gas is introduced into the tube, and a beam of the laser will be shot on the graphite target. With the effect of laser irradiation, it can generate gaseous carbon. When gaseous carbon and catalyst particles are carried by the gas flow from the high temperature zone to the low temperature zone, the catalyst is reused in order to turn into carbon nanotubes [12]. This method can be used to analyze the growth kinetics and its high crystallinity depends on a high-energy laser, the same annealing conditions, and a hydrogen-free target [13-14].

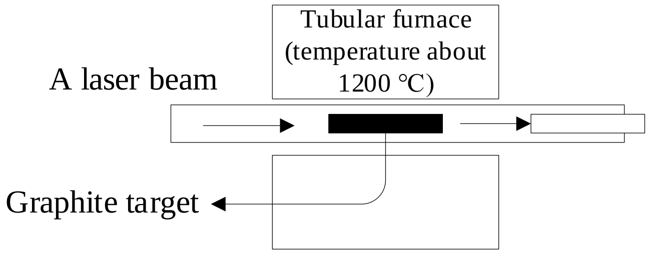


Figure 3: Device diagram of the laser ablation method.

3), Chemical vapor deposition (CVD)

The schematic diagram of the reaction device is shown in Figure 4. As early as 1959, chemical vapor deposition was used to prepare carbon fibers. In recent years, scientists have also studied the growth of carbon nanotubes without metal catalysts, carbon nanotubes are also obtained by etching nanodiamonds or fullerenes at 900 degrees Celsius while using methane as a carbon source.

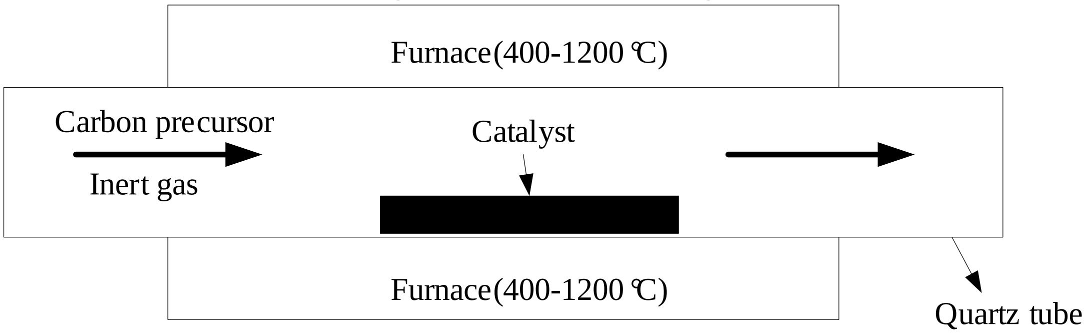


Figure 4: Schematic diagram of chemical vapor deposition method.

Through the preparation process of the three methods, the electrode chemical reaction formula can be obtained:

Electrochemical oxidation reaction when the anode is methanol:

$$VJ_3PJ + J_2P \rightarrow +6J^{\cdot} + 6R \tag{7}$$

$$R_V^P = 1.046V \tag{8}$$

Electrochemical reduction reaction when the cathode is oxygen:

$$3/2p_2 + 6r^p + 6r \rightarrow 3j_2p \tag{9}$$

$$R_V^P = 1.229V \tag{10}$$

The overall battery response is:

$$VJ_3PJ + 3/2p_2 \rightarrow +vp_2 + 2h_2p \tag{11}$$

$$F^P = 1.183V \tag{12}$$

3.2. Preparation Method and Theoretical Model of Carbon Nanotube Metal Composites

(1) Preparation method of carbon nanotube metal composite material

There are many preparation methods for metal-based carbon nanotube composites. According to the different composite metals, the most commonly used processes are powder metallurgy, high-energy ball milling, casting, etc. [15].

1) Casting

The casting method is simple and requires less cost. Composites are produced by simply mixing the liquid metal with preformed blocks or preformed powders and allowing the entire mixture to solidify. The advantage of this method is that the production time is short, the production cost is also low, and complex shapes can be formed at one time. The disadvantage is that the added body is prone to specific gravity segregation in the melt, resulting in the formation of dendrite segregation during solidification, resulting in uneven distribution of the added body. At present, it is mainly used in the preparation of low specific gravity and low melting point metals, such as magnesium and aluminum [16].

2) Powder metallurgy (PM)

Powder metallurgy is an earlier process developed for the preparation of reinforced metal matrix nanocomposites. The reinforcement and matrix powder are mixed first, and then the samples are made by pressing, sintering, and postprocessing [17-18]. Due to the powder mixing, the particle size and volume ratio of the reinforcement can be adjusted to a large proportion, and a variety of reinforcements can also be selected. After sintering, further posttreatments such as extrusion and forging can be selected to compress the pores and improve the density and material properties.

3) Mechanical alloying method

Some researchers have used the mechanical alloying method to prepare carbon nanotube-aluminum composite materials earlier and found that this method can better solve the problem of agglomeration of carbon nanotubes. Experiments are carried out with the addition of 2% and 5% of carbon nanotubes by mass. The optimal mixing ratio of ball milling time, carbon nanotube addition, and ball milling additive methanol were found [19].

(2) Theoretical model of carbon nanotube metal composites

The establishment of carbon nanotube composite material model is of great help to the further study of carbon nanotubes. In the improved Eshelby model, the calculation formula of the composite material can be obtained according to factors such as the volume content of carbon nanotubes and the shrinkage cavity of the composite material:

$$F_{12} = F_N \varepsilon_{12}^N (\varepsilon_{12}^N + \varphi_t \varepsilon_{12}^{wet})^{-1} \tag{13}$$

However, in the mixed law model (ROM), when the composite is loaded, it is expressed as:

$$F_{12} = F_t \varphi_t + F_N (1 - \varphi_t) \tag{14}$$

$$F_{12} = \frac{F_t F_t}{F_t (1-\varphi_t) + F_t F_N} \tag{15}$$

A new formula is obtained by improving the model:

$$F_{12} = \mu E_t \varphi_t + E_N (1 - \varphi_t) \tag{16}$$

However, in the Halpin-Tsai model, considering the effect of reinforcement on the composite material, the expression:

$$\frac{F_D}{F_N} = \frac{3}{8}\left[\frac{1+(2I/S)\mu_I \varphi_t}{1-\mu_I \varphi_t}\right] + \frac{3}{8}\left[\frac{1+\mu_I \varphi_t}{1-\mu_I \varphi_t}\right] \tag{17}$$

Among them, formula 17 can obtain the following expression:

$$\mu_I = \frac{F_t/F_N - 1}{F_t/F_N + 2I/S} \tag{18}$$

$$\mu_r = \frac{F_t/F_N - 1}{F_t/F_N + 2I} \tag{19}$$

Among them, the reaction kinetics equation can use the formula:

$$\frac{av}{av} = l^1[msnj_4]^n(v_y)^m \tag{20}$$

3.3. Development of Agricultural Machinery

China's agricultural machinery industry has formed a complete industrial system. At present, there are more than 8,000 state-owned holding enterprises, private enterprises, and foreign-funded enterprises, including main engine manufacturers and accessory parts manufacturers, among which 2,021 are enterprises above the designated size. Even though the scale of agricultural machinery in China is large, it cannot be said that China's agricultural machinery manufacturing industry is already advanced in terms of the overall level of industry. Compared with the industry leaders around the world, the level of manufacturing technology and equipment of China's relevant industries is about 20 years behind [20], the newness coefficient of domestic production equipment is relatively low, and the newness coefficient of some key enterprise equipment is not yet the standard stipulated by the machinery industry. Because domestic production equipment cannot keep up, the application of advanced manufacturing technology is limited, and problems such as low product quality, high material consumption, and poor economic benefits have appeared. Moreover, the product's mechanical properties, reliability, and other indicators are far lower than the level of similar foreign products.

4. Application of Cast Steel and Carbon Nanocomposites in Small Agricultural Machinery Castings

4.1. Development Level of Agricultural Mechanization in China

The ownership of major agricultural machinery in China from 2014 to 2019 is shown in Table 1. It can be seen from Table 1 that since 2014, the total amount of agricultural machinery in China has maintained a rapid growth rate, and the total power of agricultural machinery has increased by an average of 11.02% per year.

Table 1: China's 2014-2019 Major Agricultural Machinery Ownership.

Year	Total power of agricultural machinery (million kw)	Number of large and medium-sized agricultural tractors (sets)	Number of small tractors (sets)	Farm Tools for large and medium-sized tractors (part)	Farm Tools for small tractors (Part)
2014	108056. 58	5679500	17297700	8896400	30536300
2015	111728.07	6072900	17030400	9620000	30415200
2016	97245.59	6453546	16716149	10281100	29940300
2017	98783.35	6700800	16342400	10700281	2914300
2018	100371.7	4220000	18182600	4225700	
2019	102758.3	4438600	17804200	4364700	

The development trend of China's agricultural machinery total power from 2014 to 2019 is shown in Figure 5. Since the 21st century, the total power of agricultural machinery in China has grown rapidly, and the growth rate of China's large and medium-sized tractors and their supporting agricultural tools is faster than that of small tractors and their supporting agricultural tools [21-22].

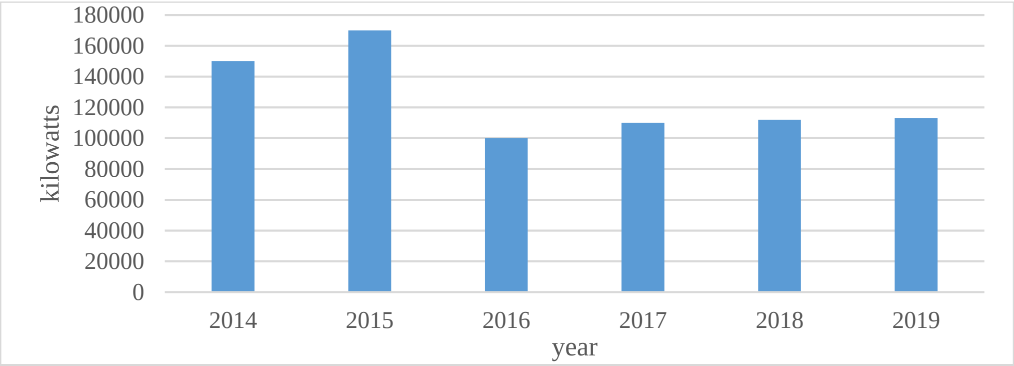


Figure 5: Development Trend of China's Agricultural Machinery Total Power from 2014 to 2019.

From 2014 to 2019, the ratio of agricultural machinery and supporting agricultural tools in China is shown in Table 2. After years of China's guidance and support for the development of agricultural mechanization, the current situation of low matching of agricultural machinery power and agricultural machinery has not been fundamentally improved, and the phenomenon of unreasonable structure of agricultural machinery equipment and its supporting facilities still exists. The total amount of agricultural machinery and equipment has increased, but the matching degree of growth rate of large and medium-sized tractors and their supporting agricultural tools is insufficient, resulting in the failure of large and medium-sized agricultural machinery to achieve optimal combination with supporting agricultural tools.

Table 2: The ratio of agricultural machinery and supporting agricultural tools in China from 2014 to 2019

Year	Large and medium-sized tractors and supporting agricultural tools supporting ratio	Small tractor and supporting agricultural tools supporting ratio
2014	1.57	1.77
2015	1.58	1.79
2017	1.59	1.79
2018	1.60	1.80
2019	1.62	1.82

4.2. Experiment of Cast Steel and Carbon Nanocomposite

45 steel was selected as the experimental steel material, using this raw material to smelt, and the carbon content of the released material is 0.40%. The experimental conditions of this smelting have been recorded, including the power adjustment of the smelting furnace and its time point, to ensure that the carbon loss and other factors of each subsequent experiment were completely consistent. The reinforcement was made of multiwalled carbon nanotubes produced by Nanchang Sun Nanotechnology Co., Ltd. The reinforcement and aluminum powder were ball-milled and cold-pressed into prefabricated blocks, the particle size of aluminum powder was 400 mesh, carbon nanotubes and aluminum powder were mixed in a mass ratio of 1:8.5 and then ball-milled and added 5% binder water glass. The mixture was ball-milled for 2 hours and then cold-pressed to become a round cake 1114. Moreover, the cake was pulverized to a particle size of 2mm and then dried at 200℃ for 6 hours. It was reserved after removing crystal water. The content of carbon nanotubes in the sample in this paper was 10% in the prefabricated block, and its content in the composite material was 0.1%.

Melting furnace model GW-0.01-50/2.bJJ, produced by Shanghai Yifeng Electric Furnace Factory. After melting, heated up the furnace to 1600 degrees and held for 10 minutes. Firstly, the deoxidizer ferromanganese, ferrosilicon, and aluminum were put in sequence and completed the work of drying the ladle before tapping the molten steel. Secondly, the prefabricated pellets were placed into the ladle and waited for the temperature to drop to the pouring temperature of 1550 degrees. Finally, the molten steel was poured into the ladle and then poured into the sample sand mold to prepare the sample blank [23]

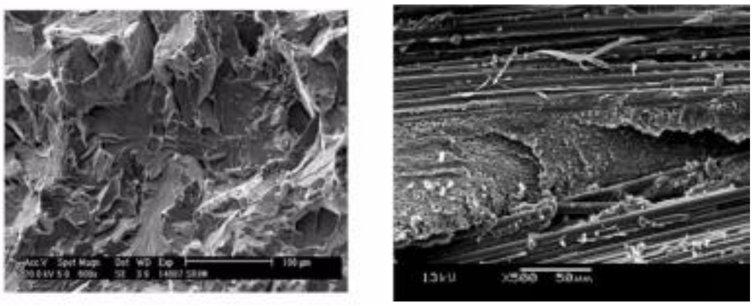
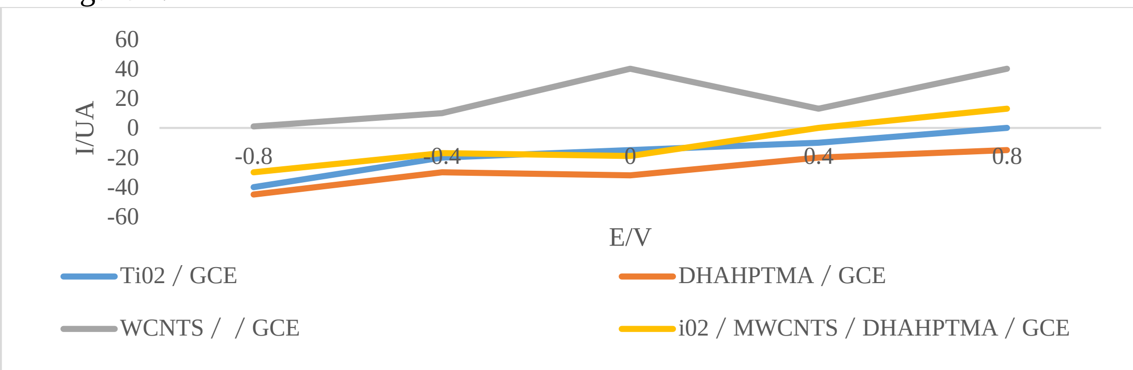
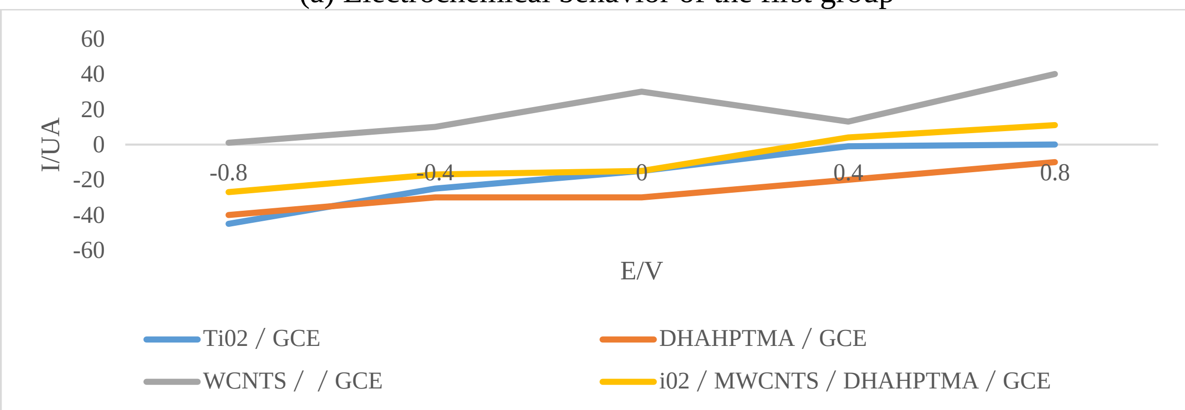


Figure 6: Tensile fracture morphology of composites.

It can be seen from Figure 6 that the fracture is composed of various forms, indicating that different structures were formed inside the composite material. The electrochemical behaviors generated in the experiments were separately recorded using cyclic voltammetry. Due to the length of the experiment, we recorded the data of two groups of periods, and the experimental results are shown in Figure 7.



(a) Electrochemical behavior of the first group

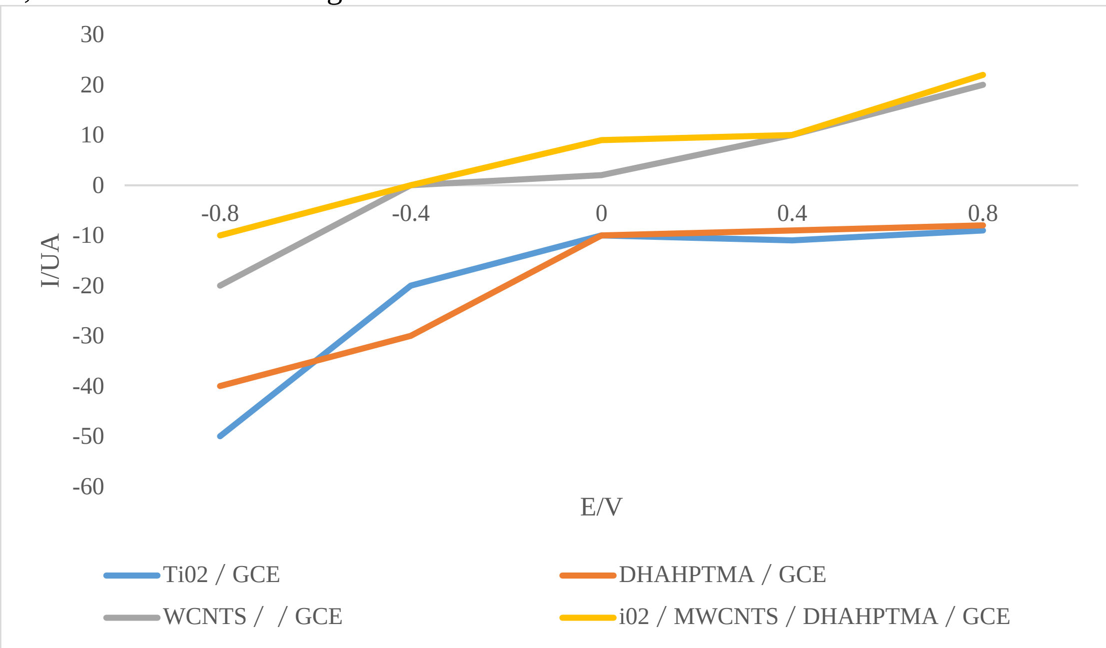


(b) The second group of electrochemical behaviors

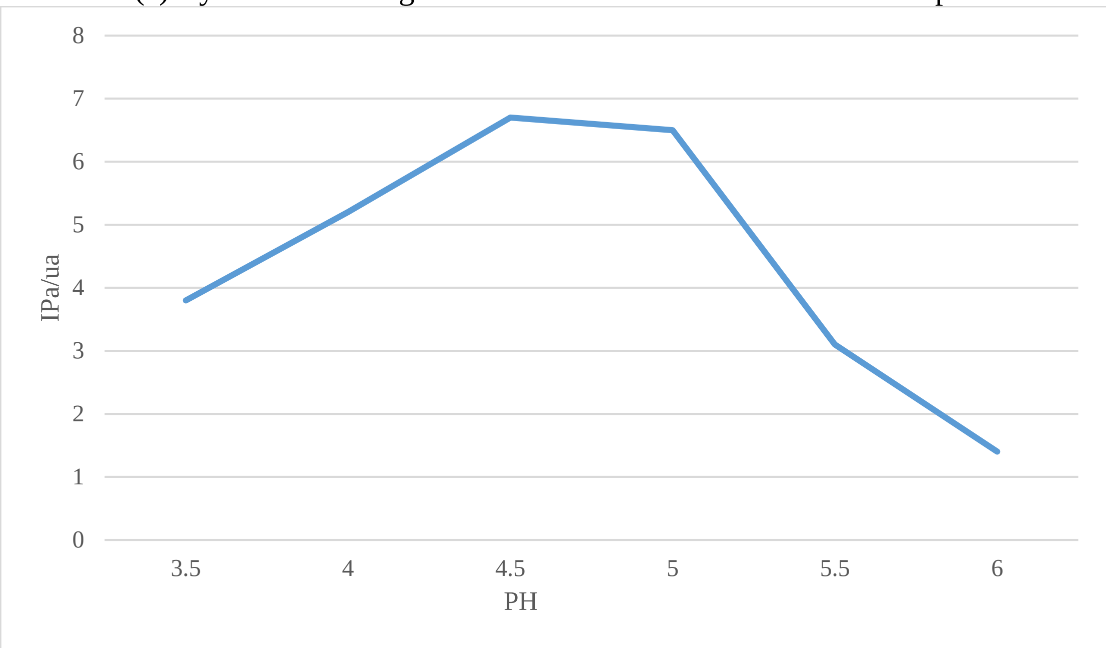
Figure 7: Cyclic voltammograms of different electrodes

It can be seen from Figure 7 that the TiO2/MWCNTs/DHAHPTMA composite film has an obvious sensitization effect to Hg (II). This is because MWCNTs have excellent electrical conductivity, Nano-TiO2 and MWCNTs with large specific surface area have excellent adsorption performance for (II), showing strong enrichment ability. Moreover, the resulting synergy between MWCNTs and TiO significantly enhanced their electrocatalytic performance.

At the same time, we also found that the scan speed could also affect the cyclic voltammetry response, as can be seen from Figure 8.



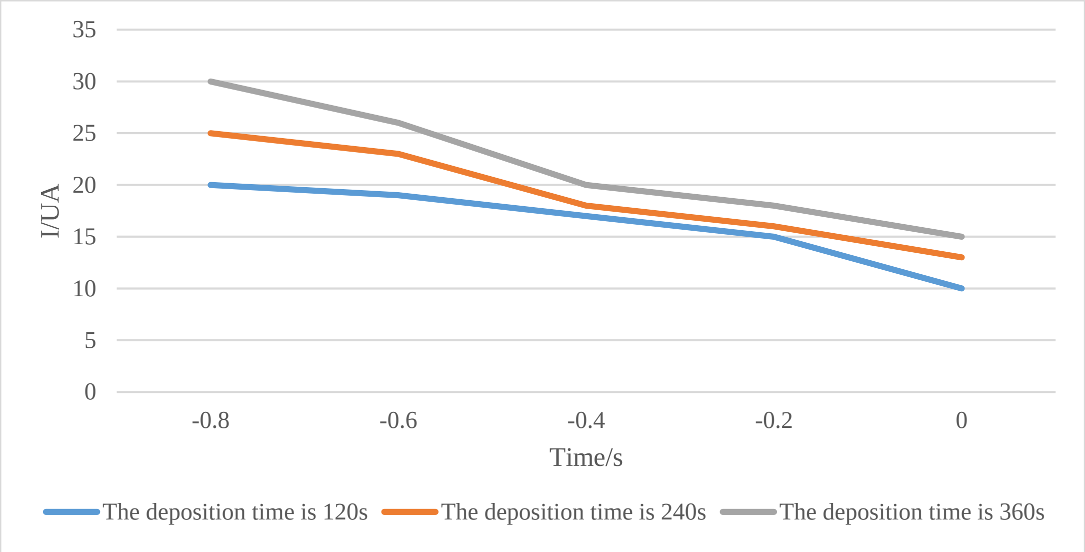
(a) Cyclic voltammograms on modified electrodes at different pH



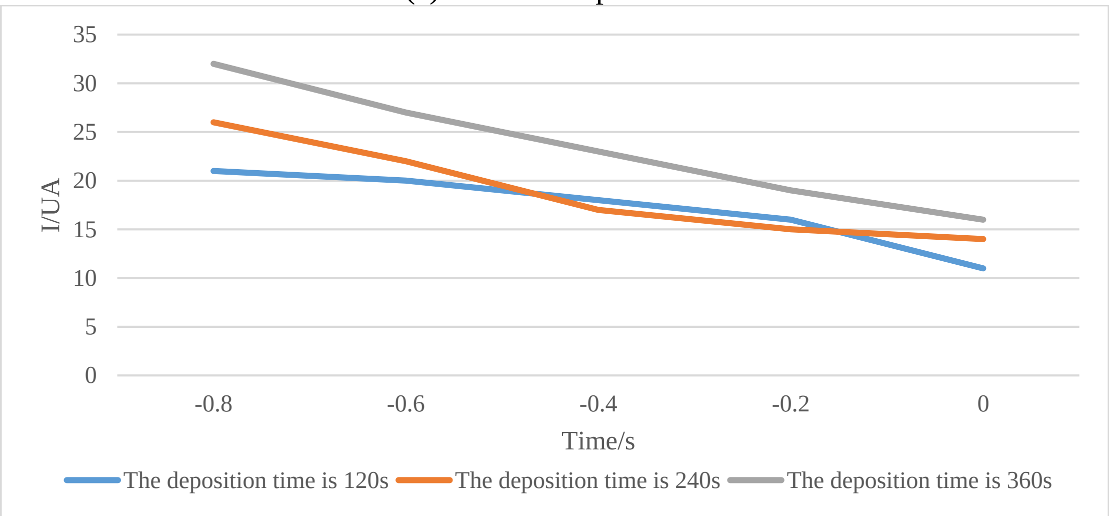
(b) Anode peak current versus pH

Figure 8. Analyzing the Response of Sweep Rate Affecting Cyclic Voltammetry

Through the above experimental analysis, it is found that the deposition potential and deposition time also have effects on cast steel and carbon nanocomposites. To this end, we conducted two sets of experiments to ensure scientific accuracy, as shown in Figure 9. The effect of deposition potential on the oxidation peak when the deposition time was 120s, 240s, and 360s.



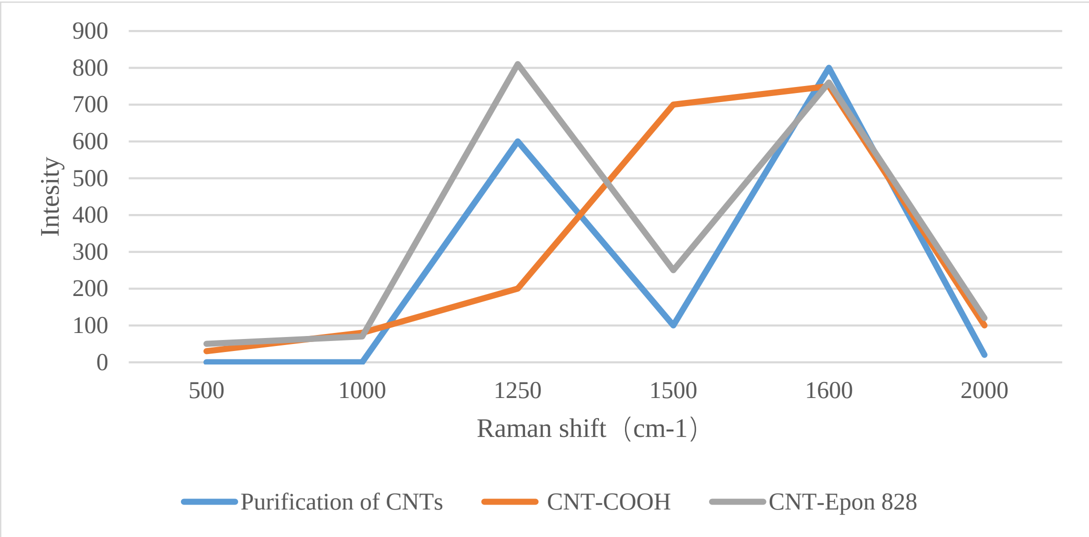
(a) The first experiment



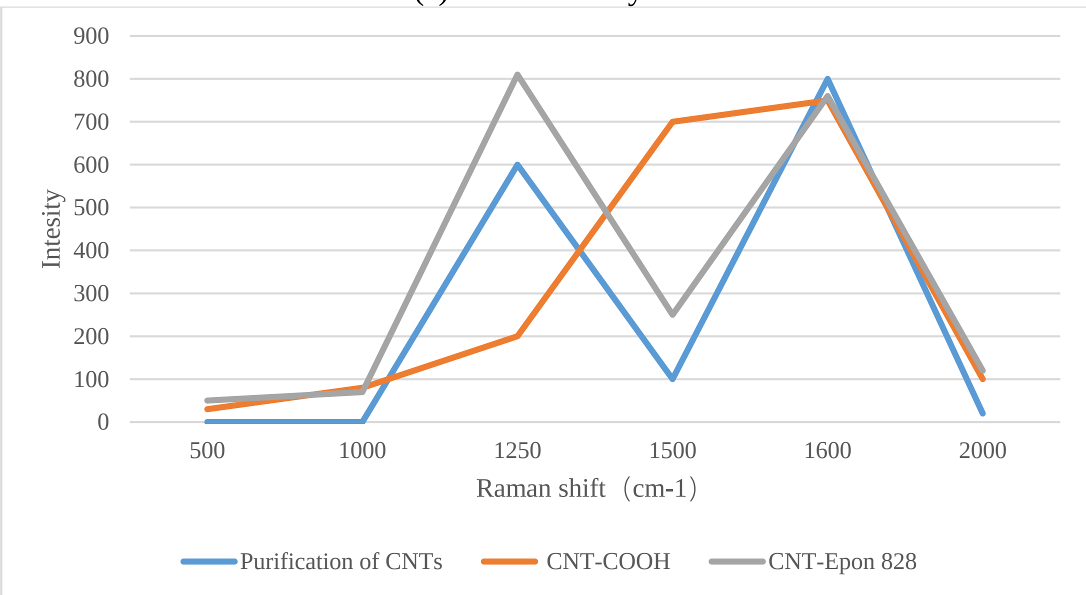
(b) The second experiment

Figure 9: The effect of deposition time and deposition potential on the oxidation peak.

Due to the structure of cast steel and carbon nanotube composites, Raman spectroscopy is also a essential means to analyze them. In order to ensure the scientificity and accuracy of the results, we performed two analyses. As shown in Figure 10, it is the Raman spectrum of the carbon tube before and after treatment. The curves (A), (B), and (C) are the Raman spectra of purified CNTs, CNT-COOH, and CNT-Epon 828, respectively. It can be seen from the figure that after the carbon tube is oxidized and grafted with Epon 828, the positions of the G and D peaks are basically the same. But the ratio of G peak and D peak decreased slightly, from 1.32 to 1.18 and 0.98, respectively.



(a) The first analysis



(b) The second analysis

Figure 10: Raman Spectrogram.

4.3. Application on Small Agricultural Machinery Castings

(1) Agricultural mechanization

The degree of agricultural mechanization is used as an index to assess the degree of mechanical operation in the process of agricultural production, that is, to measure the role of agricultural mechanization in actual agricultural production. This paper starts with the degree of mechanization of arable land, sowing and harvesting.

According to the statistical data of various agricultural mechanization operations from 2014 to 2019, the following chart is obtained. From Table 3, in the six years from 2014 to 2019, China's comprehensive mechanization rate of farming and harvesting increased rapidly from 65.38% to 71.34%. Among them, the level of machine farming increased from 86.89% in 2014 to 95.12%, the level of machine sowing increased from 50.75% to 60.23%, and the level of machine harvesting increased from 51.29% to 55.18%.

Table 3: Statistics of various agricultural mechanization operations from 2014 to 2019

Year	Level of machine-cultivated	Mechanical sowing level	Receive a level	Comprehensive mechanization of farming and harvesting
2014	86.89	50.75	51.29	65.38
2015	75.41	52.08	50.68	60.89
2016	89.64	52.56	50.68	66.84
2017	90.94	54.14	50.68	67.83
2018	93.23	55.89	52.31	69.54
2019	95.12	60.23	55.18	71.34

(2) Threshold effect of agricultural mechanization on grain yield increase

The level of agricultural mechanization in China has already been analyzed. Will the increase in the level of mechanization have a significant linear effect on grain production? In order to investigate the possible nonlinear relationship between agricultural mechanization and the proportion of grain yield, unit yield, and sown area, based on the threshold regression method of Hansen (1999), this chapter constructs a fixed-effect panel threshold model. Taking a single threshold as an example, the model is constructed as follows.

By taking Ln-total power of agricultural machinery, Ln-power of large and medium-sized agricultural machinery, Ln-power of small-scale agricultural machinery as threshold variables. The nonlinear relationship between the total power of agricultural machinery, the power of large and medium-sized agricultural machinery, and the power of small-scale agricultural machinery on grain output, grain yield, and the proportion of grain-sown area was investigated respectively in order to judge the rationality of the existing agricultural machinery input. The Bootstrap method is used to determine the number of thresholds, the estimated value of the threshold, and the F statistic. The results are shown in Table 4.

Table 4: Threshold effect test results

Explained variable	The core variables	Threshold estimate	F Statistics	10%	5%	1%
Food production	Ln-Total power of agricultural machinery	5.276	54.200*	50.808	63.214	113.178
	Ln-Power of large and medium-sized agricultural machinery	7.538	206.900***	33.316	40.855	51.856
Per unit area yield of grain	Ln-Total power of agricultural machinery	5.823	20.520**	18.725	23.531	32.274
	Ln-Power of large and medium-sized agricultural machinery	3.712	18,760**	16.613	21.026	25.908
Proportion of grain sown area	Ln-Total power of agricultural machinery	5.641	5.641	26.836	34.087	50.598
	Ln-Power of large and medium-sized agricultural machinery	3.645	3.647	28.122	31.563	41.366
	Ln-Power of small farm machinery	2.756	2.756	31.883	37.322	50.144

Table 5 shows the estimated results of the threshold effect of the total power of agricultural machinery on grain yield. It can be seen that agricultural mechanization has a threshold effect on grain output. With the continuous increase of agricultural machinery input, after crossing the threshold, the positive effect of agricultural mechanization on grain output decreases and the hypothesis in Table 5 is verified.

Table 5: Estimation results of threshold effect of total power of agricultural machinery on grain yield.

variable	Estimated coefficient	Standard error	T value
Ln- Total power of agricultural machinery (Ln- Total power of agricultural machinery ≤5.277)	0.085***	0.008	8.970
Ln- Total power of agricultural machinery (Ln- Total power of agricultural machinery ≥5.277)	0.067***	0.007	8.020
Total power of agricultural machinery × cultivated terrain	-0.155***	0.016	-9.220
The area sown	0.160***	0.012	12.830
Labor force	-0.035**	0.015	-2.190
Disaster rate	-0.000***	0.000	-4.860
Effective irrigation rate	0.002***	0.000	6.460
aging	0.003***	0.001	5.150
Share of non-farm income	0.000	0.000	1.560
Traffic conditions	0.008	0.007	1.020
constant	-1.187***	0.142	-8.280
sigma_u		0.293	
sigma_e		0.025	
R2		0.666	

5. Discussion

This paper is devoted to the research and analysis of the application of cast steel and carbon nanotube composites in small agricultural machinery castings. Through the experiments of cast steel and carbon nanocomposite materials, the mechanization data of previous years are analyzed, a mechanized threshold model is established and applied to the analysis and processing of small agricultural machinery castings. It not only expands the application scope of carbon nanotubes, but also a new attempt to research the methods of agricultural mechanization in China. Through the analysis of the data obtained from the experiment, carbon nanotube composites as an important tool used in small agricultural machinery castings have a certain potential in the research of the complexity of carbon nanotubes and agricultural machinery castings. In addition, China has been following up the development of agricultural mechanization. In recent years, the level of agricultural mechanization has reached a certain height, as regarded to the research on the application of carbon nanotube composites to small agricultural machinery castings. This paper starts with the most basic description of the structure, properties and preparation of carbon nanotubes, then conducts experiments on cast steel and carbon nanotube composite materials, and then makes a mechanized threshold model in order to successfully and clearly express the role of carbon nanotube composite materials in promoting agricultural machinery casting. In the empirical analysis stage, the data combination is obtained by using experiments and models, and the data is analyzed in many aspects. The results show that the obtained results are in line with the actual situation.

Through the analysis of this case, it is shown that the application of cast steel and carbon nanotube composite materials in small agricultural machinery castings will be more effective in agricultural mechanization as well as improving the level of agricultural mechanization. In specific experimental applications, carbon nanotube composite materials are developed and used in small agricultural machinery castings, which reasonably and flexibly improve the goals of agricultural mechanization. The preparation method and threshold model are analyzed to obtain accurate data and thus draw conclusions. In the application of carbon nanotube composite materials, it will have a great thrusting effect on agricultural mechanization in small agricultural machinery castings.

In this paper, the carbon nanotube composite material experiment and threshold model are used for research. Through the overview of the performance of carbon nanotubes and the qualitative analysis of the current level of mechanization development in China, as well as using the experiments of cast steel, carbon nanotube composite materials, and the analysis of the threshold model to conclude that the use of carbon nanotube composite materials for castings has well promoted the development of agricultural mechanization in China.

6. Conclusions

Through case studies, essential conclusions have been drawn: Carbon nanotube composites have a wide range of applications. The application of cast steel and carbon nanotube composite materials in small agricultural machinery castings can well promote the development of agricultural mechanization and improve the level of agricultural machinery castings. According to the experimental data analyzed in this paper, this requires more detailed research and quantitative analysis of carbon nanocomposites in order to obtain more results that are effective. The project discussed in this paper is the role of carbon nanotube composites in the application of small agricultural machinery castings, and the selection of projects is relatively limited, whereas large-scale agricultural machinery castings will often face various combinations of choices, and in reality agricultural machinery has developed very well. Those combinations may have greater value, of course, will have greater difficulty.

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