TECHNOLOGY OF DEPOSITING COPPER ON THE SURFACE OF CARBON FIBERS

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Abstract

Densely distributed copper coating has been deposited on the surface of carbon fibers by the electroless plating method. One method was that the carbon fibers could be deposited with copper directly without surface treating when the plating bath reaction temperature was from 40 to 70℃. The copper layer could be attained directly. The other manner had been found that the pretreatment of the carbon fibers was very important to obtain the copper particles on the carbon fibers at room temperature. In our experiments, pretreatment of replacing $PbCL_2$ with AgCL as activator was found to be effective.

Introduction

Electrically conducting metallized fibers is one of important varieties of carbon fibers. Because of its high electrical conductivity, low coefficient of thermal expansion and low density, this kind of carbon fibers will be widely used in electromagnetic shielding material, intelligent cement and transmit electricity material. Uniformly distributed copper layer have been deposited on the surface of carbon fibers by the electroless plating method (Chen Kun. 1994. Karthikeyan Herry. 1994).

It is difficult for most metals to be deposited directly onto the surface of carbon fibers. Therefore one way is that the electroless plating bath was done at from40 to 70℃. The other way is that a pretreatment is used to form functional groups on the fibers surface providing for the nucleation of the metals or their compounds. Thus the deposition process could be performed at room-temperature (Wan Y Z. 1996).

Experimental

The carbon fibers used in experiments were T-300 made by Japan. One means was the copper particles were deposited on the surface of the carbon fibers directly when the bath reaction temperature was from 40 to70℃.

The other method was before electroless plating, pretreatments including oxidation, hydrophilic treatment, sensitizing treatment, and activating treatment were performed on the carbon fibers. Oxidation: carbon fibers were immersed in the mixture of H_2SO_4 and HNO_3 for 3 days. The carbon fibers were washed with distilled water and neutralized with NaOH. Sensitization and activation: the surface of carbon fibers has low chemical reactivity and does not act as a catalyst for the deposition of the copper and no metal coating takes place. As a consequence, a preactivation (surface catalyst) was needed and this was accomplished by immersion of carbon fibers for 3 minutes in aqueous solution of 0.4MSnCL-0.4MHCL, followed by rinsing in distilled water and immersion further 4 min in an

aqueous solution of 0.029MAgCL instead of $PdCL_2$ of the known procedure. The oxidation, neutralization, sensitization and activation were in order to add activated sites. The activated carbon fibers were washed with distilled water and then introduced the electroless bath. All the deposition experiments were done with pneumatic stirring procedure (Rohatgi P K, Nath D and Shittah Z Y. 1991).

The samples 200mm in length were measured by microhmmeter. The surface morphology of the carbon fibers after electroless plating was observed and analyzed by the scanning electron microscopy (SEM).

Results and Discussion

After a series experiments the optimal composition of copper electroless plating bath is determined. The copper bath constitutions of the electroless plating procedure are listed in Table 1.

Table 1. Composition of copper electroless plating bath

compound	Concentration
$CuSO_2$	10(g/L)
HCHO	30(ml/L)
$C_4H_4KNaO_6 \cdot 4H_2O$	50(g/L)
NaOH	20(g/L)

The resistance of raw fibers is 28.8Ω. Fig. 1 shows the changes of resistance and rate of liveweight growth at different electroless plating bath temperature. It was observed that the resistance decreased a lot and at the same time the weight increased a little, especially the resistance reduced to 0.284Ω after plating at 60℃ and the percentage of liveweight growth was 2.037g/g. The investigation indicates that the high temperature plating process is feasible and simple.

The resistance reduced to 0.318Ω and the rate of liveweight growth was only 1.412g/g after pretreatment course and the plating reaction could be performed at room-temperature. It is found that the manner with pretreatment is more effective and complicated and AgCL used as activator instead of conventional $PbCL_2$ is feasible.

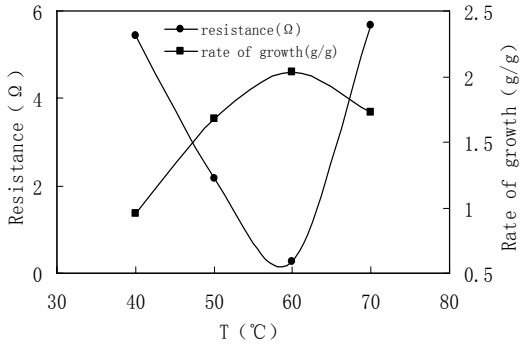
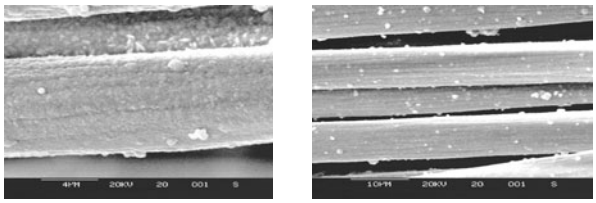
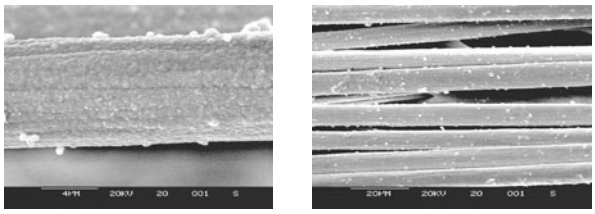


Fig 1. Resistance and rate of growth curve at different bath temperature

Fig. 2 shows there was a continuous, compact and uniform copper layer deposited on the surface of carbon fibers in both ways.



(a) at 60℃ without pretreatment



(b) with pretreatment

Fig 2. SEM images of carbon fibers with continuous copper layer

Conclusion

An immediate way to deposit copper particles on carbon fibers by the eletroless plating has been demonstrated. The electroless plating bath experiments were done at from 40 to70℃. The preliminary investigation indicates that this method is feasible and simple. It has been found that the pretreatment of carbon fibers is very important in electroless plating process at room-temperature. In this study AgCL instead of $PbCL_2$ which is a kind of conventional and expensive activator was used. It is thus suggested that this pretreatment is quit effective and less expensive. The copper deposition of carbon obtained by these two methods is uniform, compact and adhesive, so the carbon fibers have good electric characteristic.

References

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