Chracteristics of Fine Copper Powder by Pulse Applied Electrodeposition

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Introduction

Ultrafine Cu powders have been widely used in electrically conductive coatings and catalysts such as micrometre-sized Cu powders used for electric uses (e.g. conductive paste in electronic technology..) and nanometre-sized Cu powders for catalysts (e.g. catalysts). When being ultra micro, the surface of Cu particles becomes easily to be oxidized. Therefore, the improvement of oxidation resistance was a key issue for ultrafine Cu powders increasing the purity.

The nucleation rates for 3D clusters are proportional to: exp(-B/2.k.T) is the absolute value of the overvoltage, A and B are constants, K is Boltzmann's constant, T is the absolute temperature.

The factors make favor the formation of powders with high dispersed and small particle:

1. High inhibition intensity 2. Low electrolyte concentration
3. Low electrolyte temperature 4. Low electrolyte flow rate.
5. High current density

The aim of this study are preparation of Cu powders with high purity by electrodeposition, investigation of the effect factors on morphology and particle size of Cu powders, icreasing the dispersion of Cu powders and finding the optimized condition of anti-oxidant treatment act as the most important role to increase the purity of Cu powders.

Experimental

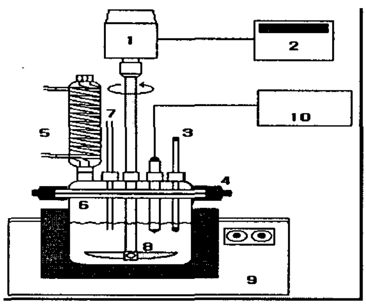


Fig. 1 Apparatus for anti-oxidant treatment of Cu powders. 1. Rotor 2. Power supply 3. Thermometer 4. Clamp 5. Condenser 6. Reaction bath 7. Thermocouple 8. Impeller 9. Heating mantle 10. Feeding pump.

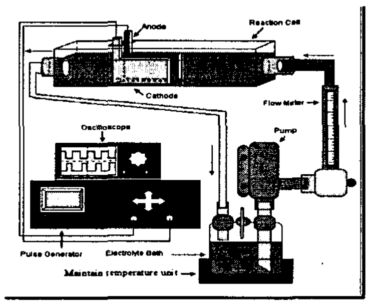
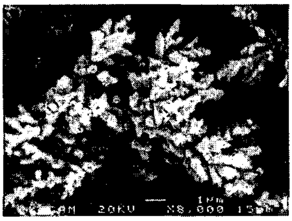
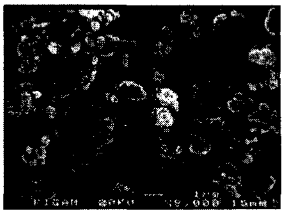


Fig. 2. Apparatus for preparation of Cu powders by electrodeposition.

Result and discussion

1. Effect of electrolyte flow rate





2 L/min 4 L/min 6 L/min

Fig.7 Effect of Flow rate on morphology of copper powders. Cu concentration: 5g/l gellatine: 5g/l, supporting electrolyte: 25g/l, current density: 40A/dm2, temp.: 25oC

2. Effect of reverse pulse applied current

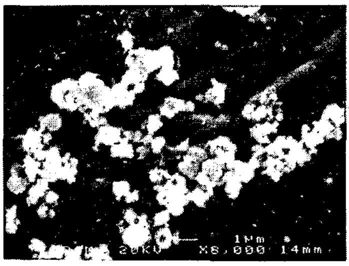
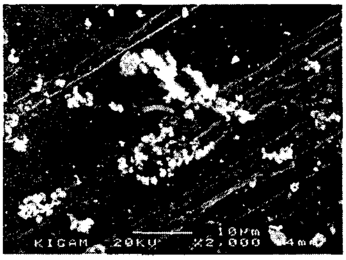



Fig.4 Effect of reverse pulsed current on morphology of copper powders.Cu concentration: 5 g/l, positive current density: 40 A/dm^2, negative current density:15 A/dm^2, supporting electrolyte:50 g/l, positive pulse-to-stop ratio 30 %, negative pulse-to-stop ratio: 20 %, temp.: 25°C

Conclusions

1. Prepared successfully Cu powders with high purity (around 99.99%) and good thermal stability under 100 °C.

2. Adopting pulsed current decreases the dendritic growth of Cu powders.

3. Reverse pulsed current acts as strong inhibitor inhibits dendritic growth to form ultrafine Cu powders.