

## Introduction of Engineering Creativity

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### 1 Engineering Creativity

An Engineering Creativity course is held the second semester. About 500 students take this course every year. This course has one class a week. Students can choose any subject they want focus on. Students are supposed to learn how to solve problems by themselves. At the end of this course, we give a presentation on what we learn.

We chose “metal leaf” as our focus of study.

### 2 Purpose of our course

In some conditions, metal is deposited along the interface between organic liquid and aqueous solution like leaves. We call it “metal leaf”. The shape of these leaves depends on voltage, distance between electrodes, and anode shape. Therefore, the purpose of our research is to examine these factors to control metal leaf growth and get bigger metal leaves.

### 3 Method of experiment

Equipment for this experiment is assembled as shown in Figure 1.

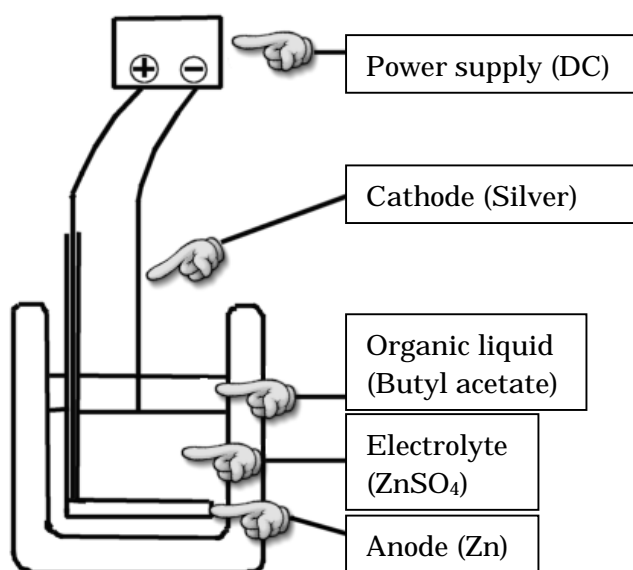


Figure 1 Device of this experiment

The cathode is a silver wire. The anode is a zinc metal plain plate. The electrolyte is 3 mol/l zinc sulfate aqueous solution. The organic liquid is butyl acetate. We slowly poured organic solution into the

beaker to create the interface. The silver wire was slowly lowered into the organic liquid layer. When the head of the wire reached the interface, the electrolytic deposition started. The most important thing is to place the top of the cathode exactly at the interface.

We studied the effects of the voltage, anode shape and distance between electrodes.

### 4 Result of this experiment

Voltage effect: We changed the voltage from 2 V to 7 V. At 2 V and 7 V, we got a typical dendritic deposition. At 3 V, we got the biggest leaf of all.

Effect of distance between electrodes: We changed the distance from 3 mm to 20 mm. At 5 mm, the deposit is dendritic. The others are metal leaves. At 10 mm, the deposit became the biggest and the densest of all.

Effect of anode shape: Metal leaf growth depends on the anode size. On the star shaped anode, we got a pentagonal leaf.

Depth of organic solution effect: We changed the depth from 2 mm to 5 mm, but it did not effect the deposit.



Figure 2 Deposit on circle and star shaped anode

### 5 Conclusion

From these experimental results, we concluded that when the voltage was 3 V, the distance between electrodes was 10 mm, the anode shape was circular and the size was bigger, we could get the biggest and best-shaped metal leaves.

The mechanism of metal leaf growth is unknown. Therefore we have to conduct further investigation.