The Growth Process of a Metallic Leaf

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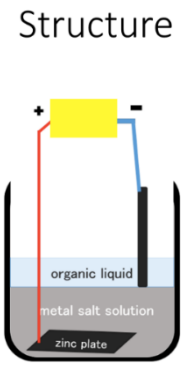
1. Abstract

"Metallic leaf" is a layer of metal that forms when you run an electric current through the border that forms between two different kinds of liquids, such as a metal aqueous solution and an organic liquid. Several studies have reported that a metallic leaf grew larger and film-like shape under high temperature and voltage. The purpose of our study is to examine the characteristics of a metallic leaf in detail to understand why it grows under the condition previously mentioned.

2. Experiment

2.1 Preparation for Experiment

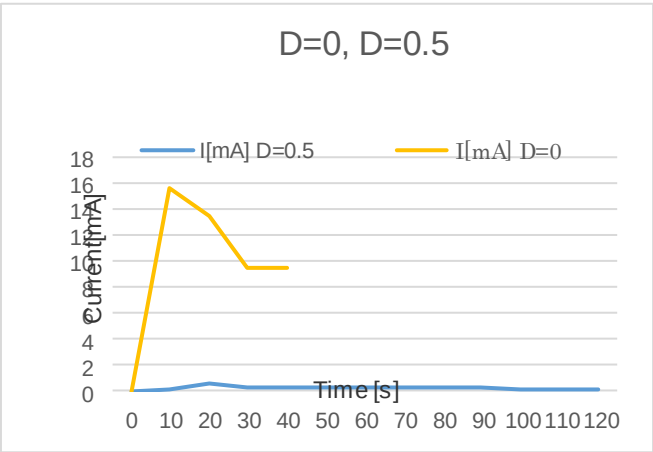
We poured zinc sulfate solution, whose concentration was 2.0mol/L and butyl acetate, an organic liquid that does not dissolve in water into a lab dish. In order to make a metallic leaf grow at the border of the two liquids, we placed the tip of a carbon stick at the border of the two liquids, soaked a zinc plate in a solution, and connected them to a power source. The whole structure is as follows: (figure1)



(figure1)

2.2 How to Measure Current Intensity

We used two testers whose electrode can measure current intensity precisely and set one tester at the border of two liquids, and the other under the border. Let us call them tester (D=0) tester (D=0.5) respectively. D represents the distance [cm] from the border of the two liquids).The two electrodes of each tester were set the same distance from a carbon stick so that we were able to compare which setting was easier to run an electric current through and which was likely to gather ions.



(graph*3)

All parts of two electrodes of tester(D=0.5) except for the tip of it was covered over by a robber in order to prevent electrons at the border from getting into that electrodes.

After setting the voltage at a power source by 5.0V, we recorded the value of current intensity at each spot every ten seconds.

3. Results

3.1 Results of measuring of electric current

We performed the same experiment five times at the temperature of 20.5 degrees Celsius. The above graphs express the average transition of current intensity at the border (D=0) and that under the border (D=0.5).

Obviously, current intensity (D=0) was much bigger than that (D=0.5) and both of them were same value.

3.2 form and mass of a metallic leaf (graph3)

The mass of a zinc leaf ranged from 0.05g to 0.07g. Also, all forms of a zinc leaf in every experiment was like the picture shown above, suggesting that the shape of a metallic leaf does not change under different condition.

Experiment	1	2	3	4	5
Mass[g]	0.05	0.07	0.06	0.05	0.07

(graph3)

3.3 thickness of a metallic leaf

The results were as follows: (graph4)

These results enabled us to estimate the thickness of a metallic leaf although there were some variabilities in it.

Experiment	1	2	3	4	5	6
Thickness[10^(-5)m]	3	1	3	1	2	2

(graph4)

4. Discussion

4.1 Discussion about the strength of the electrical current

The amount of the current at the border increased extremely, and we thought the reason is ions gather at the border. The reason why metallic leaf appears only at the border has not been identified.

However if we assumed that the polar in organic molecules attracts zinc ions and the concentration of zinc ions becomes high at the border, we can illustrate that zinc appears only at the border. However we couldn't get the direct proof of it.

4.2 Discussion about Mass and Form of Zinc Leaf

The mass and form of metallic leaf didn't change very much after five trials. This shows the accuracy of the experiment.

4.3 Discussion about the Thickness of a Metallic Leaf

The thickness of it changed greatly. We believe the reason is we couldn't measure the metallic leaf accurately and we didn't consider the roughness of the surface affecting our measurements.

5.1 Conclusion

We understood a metallic leaf's shape does not change under different electric current levels and we were able to measure the thickness of a metallic leaf.

We believe the reason why a Zink appeared at the border is related to the poles of the organic molecules.

6. Assignment

We need to find evidence that distribution of zinc ion in a solution is imbalanced.
We have to measure the exact thickness of a metallic leaf with interference of light.

7. References

Hiroyuki Kaneko Morphologies Metal Leaves 1991, p 985-

8. Key words

Metallic leaf, Zinc, Aqueous solution of zinc sulfate