

Presented by Austria I in the finals:



The Liquid Diode

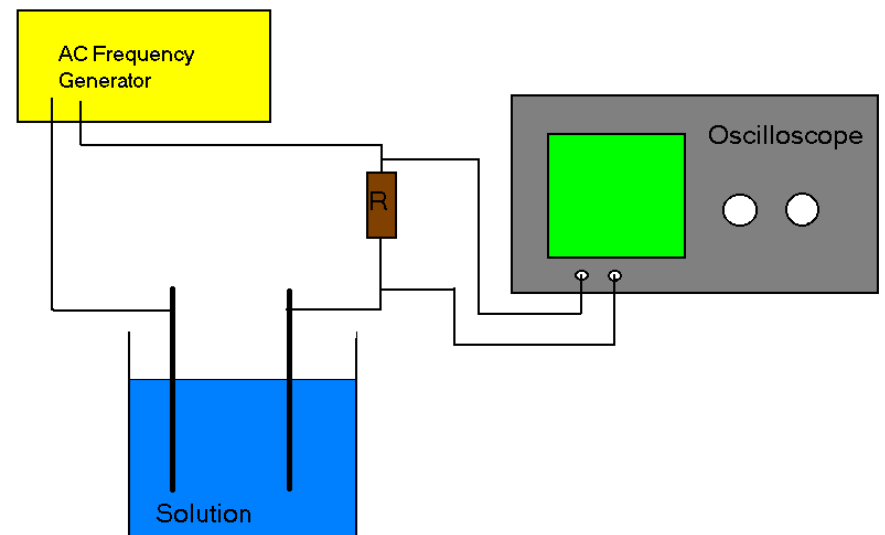
The Liquid Diode



- Fabrication
- Origin of the diode effect
- Frequency dependence
- Parameters that influence the frequency dependence

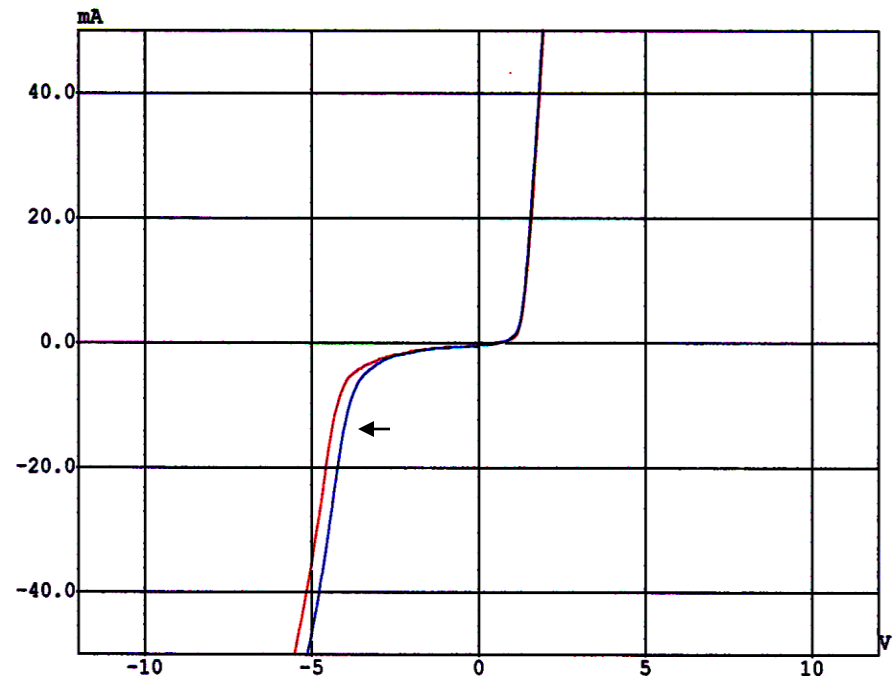
Experimental Setup

- Low frequency generator
- Aluminium electrode
- Iron electrode (or lead)
- Sodium-di-hydrogenophosphate solution (or sodium-carbonate)



Observations

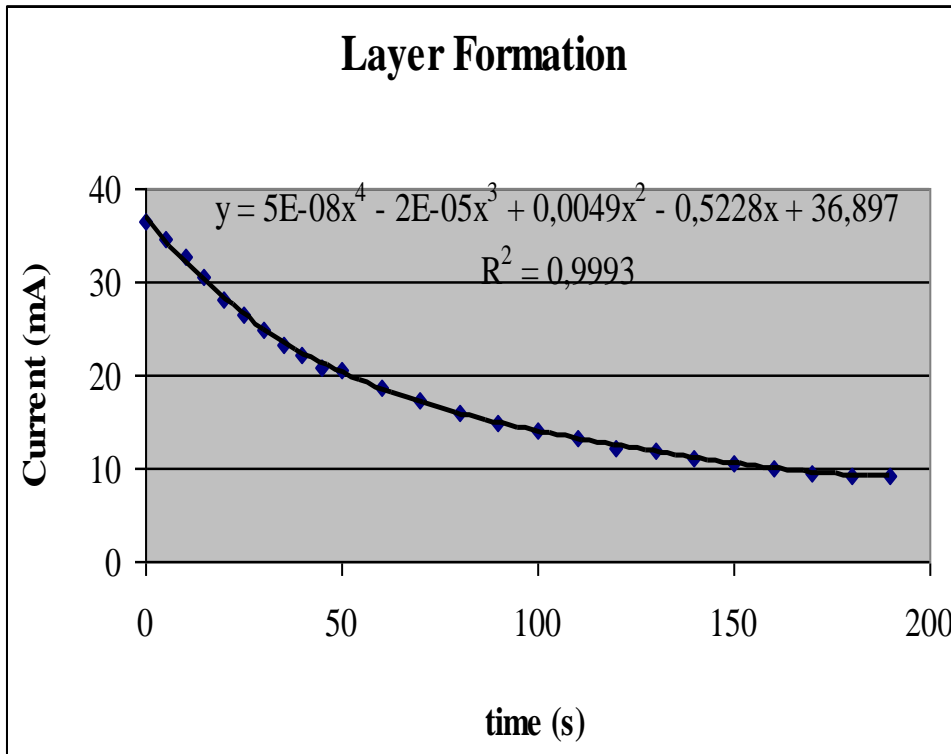
- The diode effect increases with the time
- At the same time there is a formation of alumine Al_2O_3 . We can therefore assume that the increase of the diode effect is due to the formation of this layer.



Fabrication of the layer

- To have a constant diode effect, we created the layer by applying a direct current
- We created the aluminium-hydroxide layer with different constant voltages (3V, 5V, 10V, 30V) to obtain a different layer thickness
- During the layer fabrication, the current does not decrease like an exponential.

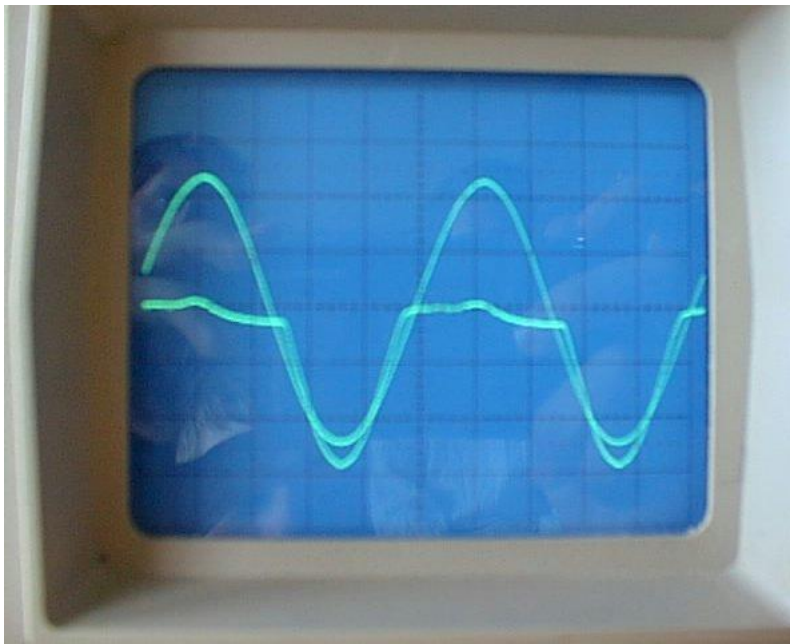
Layer Formation



We built the alumine layer with a 8V battery.

The current decreases, the curve is far from being exponential.

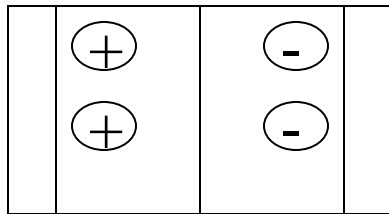
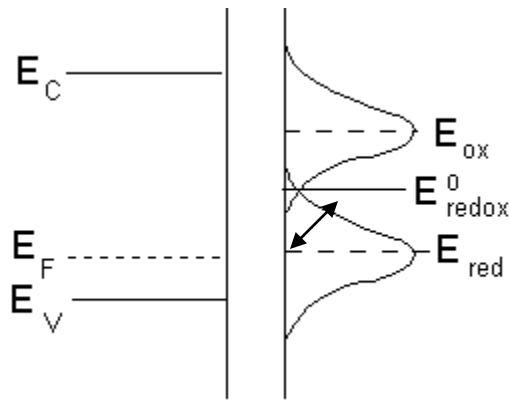
The Diode



- When the layer is formed, we have a very good diode at low frequencies.

1 Hz, 1 mol.L⁻¹

Explanation of the Diode Effect



Al(OH)₃

Electrolyte

Alumina and Al(OH)₃ react like a semiconductor.

The Al₂O₃ layer and the electrolyte have different average energies.

This causes a migration of charges and the formation of an area without charges

Influence of Frequency on the Diode Effect



Note of the author:

At this point of the presentation, the reporter demonstrated the evolution due to frequency on an oscilloscope.

Frequency Dependence

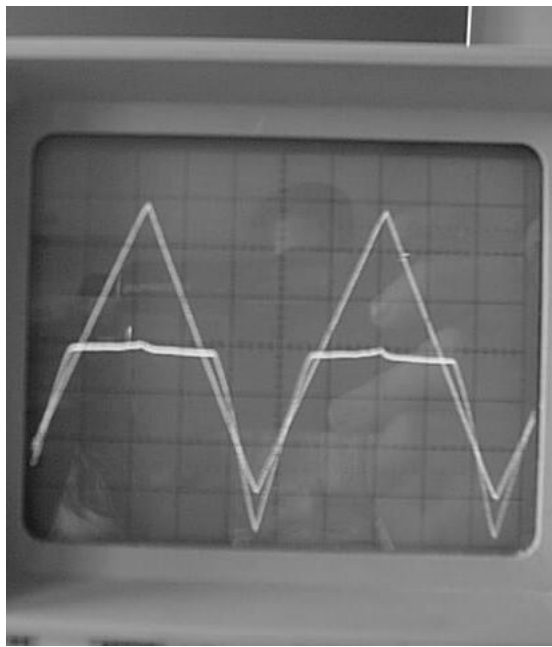
Assumed parameters :

- size of the aluminium electrode
- quantity of alumine
- temperature of the electrolyte
- concentration of the electrolyte

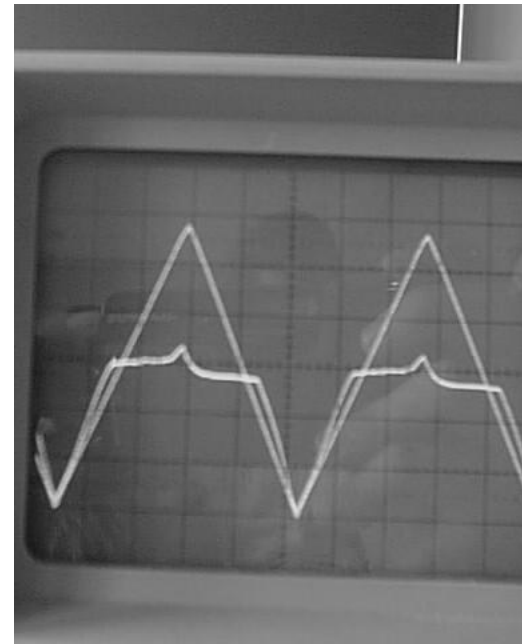
Parameters

- Size of the electrode : with a smaller electrode, the diode is better for higher frequencies (*more than 100 Hz with a wire*).
- The temperature of the electrolyte does not influence the diode effect.
- If there is more Al_2O_3 , the diode is better for higher voltages: the diode works well up to the formation voltage.

Influence of Concentration



1Hz, 1 mol.L⁻¹



1Hz, 0.2 mol.L⁻¹

Conclusions

- The liquid diode works for low frequencies (up to about 20 Hz).
- The evolution of the diode effect with the frequency depends on the size of the electrode, the quantity of alumine and the concentration of the electrolyte.