

# Antibubble

## 1. What's an antibubble?

What's this?



Soap bubble

What's this?



Antibubble

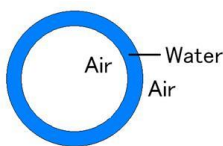
What's the difference between these two objects?

A soap bubble is formed in the air.

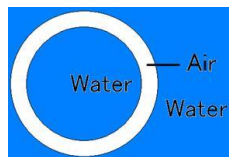
An antibubble is formed in the water.

A soap bubble is air surrounded by the thin film of water.

An antibubble is a droplet of water surrounded by the thin film of air.

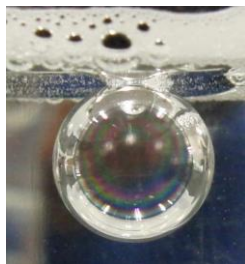


Soap bubble



Antibubble

We can observe interference colors on the surface of both these objects.



Interference colors

## 2. How can we make an antibubble?

### Preparations

tap water, straw, detergent, tank or glass



Detergent



straw, tank

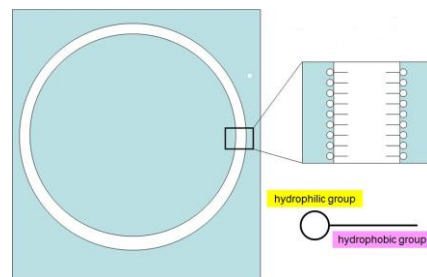
### Experiments

1. Pour the water into the tank.
2. Add a little detergent.
3. Sink the end of a straw into the solution.
4. Close another end of a straw with fingertip.
5. Lift the straw from the surface of the solution keeping the fingertip on another end of a straw.
6. Hold the end of the straw near the surface of the solution.
7. Let go of the fingertip from another end of a straw.

### 3. Structure

The air-liquid interface is composed of oriented surfactant molecules.

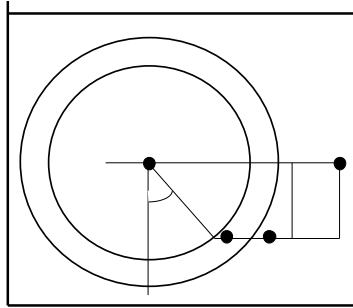
This particular structure ensures air-shell stability.



Oriented Surfactants

#### 4. Buoyancy

Buoyancy brings antibubbles towards the surface where they stick before naturally pop up.



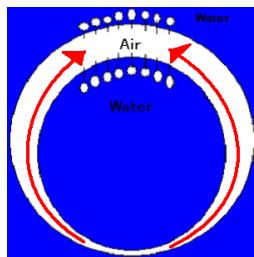
Buoyancy

$$= \int (p_0 + \rho g r \cos \theta + \frac{2\gamma}{r}) \cos \theta dS$$

$$= \frac{4}{3} \pi r^3 \rho g$$

#### 5. Collapse

The gravitational thinning of the air film occurs at the bottom. So air-shell breaks at the bottom and the film quickly collapses in the direction to the top.



To be continued

#### References

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To be continued