**Maximum bubble pressure method**

(http://en.wikipedia.org/wiki/Bubble_pressure_method)

One of the useful methods to determine the dynamic surface tension is measuring the “maximum bubble pressure method” or, simply, bubble pressure method. [1][2]

Bubble pressure *tensiometer* produces gas bubbles (ex. air) at constant rate and blows them through a capillary which is submerged in the sample liquid and its radius is already known.

The pressure \( P \) inside of the gas bubble continues to increase and the maximum value is obtained when the bubble has the completely hemispherical shape whose radius is exactly corresponding to the radius of the capillary. [2][3]

Figure 2 shows each step of bubble formation and corresponding change of bubble radius and each step is described below. (Image was reproduced from reference) [2][3]

![Figure 2 – Change of pressure during bubble formation plotted as a function of time](image)

A, B: A bubble appears on the end of the capillary. As the size increases, the radius of curvature of the bubble decreases.
C: At the point of the maximum bubble pressure, the bubble has a complete hemispherical shape whose radius is identical to the radius of the capillary denoted by R_{cap}. The surface tension can be determined using the Laplace equation in the reduced form for spherical bubble shape within the liquid. \[ \sigma = \frac{\Delta P_{\text{max}} \times R_{\text{cap}}}{2} \]

(\sigma: surface tension, \Delta P_{\text{max}}: maximum pressure drop, R_{cap}: radius of capillary)

D, E: After the maximum pressure, the pressure of the bubble decreases and the radius of the bubble increases until the bubble is detached from the end of a capillary and a new cycle begins. This is not relevant to determine the surface tension. \[ \text{[2][3]} \]

Currently developed and commercialized tensiometers monitors the pressure needed to form a bubble, the pressure difference between inside and outside the bubble, the radius of the bubble, and the surface tension of the sample are calculated in one time and a data acquisition is carried out via PC control.

Bubble pressure method is commonly used to measure the dynamic surface tension for the system containing surfactants or other impurities because it does not require contact angle measurement and has high accuracy even though the measurement is done rapidly. \[ \text{[1][2][3]} \]

“Bubble pressure method” can be applied to measure the dynamic surface tension, particularly for the systems which contain surfactants. \[ \text{[4]} \]

Moreover, this method is an appropriate technique to apply to biological fluids like serum because it does not require a large amount of liquid sample for the measurements. \[ \text{[4]} \]