

# Conditions to generate spiral movement of molecules in water indicated by the observations of bubble behavior in vicinity of the ice of carbonated water

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**Summary:** When carbonated water was frozen from the surrounding, groups of tunneling bubbles of CO<sub>2</sub> were appeared at the central area in the glass container. Although those tunnels looked like sea urchin spines, the groups of tunnel are partially arranged in parallel. At the final stage of dissolution of this ice, spherical sandwich structured bubbles are released into the water. In the spherical sandwich structure, the torso region in which contains bubbles is sandwiched between white bubbles. The torso region is stretched if the distance between white bubbles at both sides expands. When another bubble approaches, the torso region of sandwich will coalesces with the bubble, as if it swallows the bubble. If the upper bubble separates from the lower bubble, it causes rapid movements of bubble by the region of torso that will be changed to active state. The observations of these phenomena and the results of considerations on the mechanism are described.

**Preparation of materials:** The ice takes various structures depending on the freezing conditions. The ice that is frozen from carbonated water with containing dry ice contains many gaps complexly. The ice that is frozen from carbonated water containing Na ions cannot form helical structure. The molecule of water becomes tetrahedral units, because oxygen atom in the water has the sp<sup>3</sup> hybrid orbital, and the bond angle between two hydrogen atoms is 104.5 °. The spiral structure of ice will be formed at the area where tunnels of bubble are arranged in parallel, because there are through holes of the gap along vertical direction of in the plane of electrical axes. Here, the spiral structure is similar to α-quartz. The spiral structure has electrical axis in three directions. The crystal of ice grows along the plane of the electrical axes.

**Method of observations:** In order to observe the ice and bubbles by the reflected light, the background should be black to absorb the light. The photographing was carried out at close distance of 1cm by using a digital camera PENTAX Optio-W90. The movement of bubbles was observed by frame-by-frame in the pictures of the movie at 30 frames per a second, because the shutter of the digital camera is quick compared to human's eye. But a coalesce of bubble took place within the period of one frame. The flicker noise in the video captured by digital camera at high digital magnification cannot ignore. Sometimes, synchronized motions of small bubbles due to the wave by rupture of bubble on the surface of water were observed.

**Conclusions:** Since three oxygen atoms of (CO<sub>3</sub>)<sup>2-</sup> in carbonated water are arranged triangle in a plane, it promotes formation of the membrane of a bubble. The spiral structure of water molecules will be formed in contact with the membrane. The cohesive energy that is gained by the spiral structure works as a weak vertical cohesive force between membranes of bubbles, it forms a sandwich structure of bubbles. The spiral region makes coalescence with neighboring bubble. When the position of hydrogen bond becomes changeable, the thermal vibrations around electric axis become rotational movement of the spiral structure. The helical motion that holds the spiral structure transports molecules in one direction. The helical motion causes rapid movement of the bubble. As the conclusion, the observed phenomena are explained by the effect that is caused by the spiral region formed in the carbonated water in contact with membrane of bubbles.