Electrochemical performance of ultrafine bubble water

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The electrochemical performance of ultrafine bubble (UFB) water[1, 2] is reported herein. Recently, UFB has found applications in various fields[3, 4, 5, 6]. However, the detailed mechanism underlying the performance of UFB is not known, although the relevance of ions (proton and hydroxide ion) in solution has been discussed. Therefore, we investigated UFB through electrochemical measurements. First, we conducted a preliminary experiment in an ultrafine bubble generator (BUVITAS HYK-32-D, KYOWA KISETSU) and a measuring device for the concentration of microparticles (NANOSIGHT LM-10, Quantum Design, Inc.)[7]. We also measured the electrical conductivity (S230, Mettler Toledo) and pH (LAQUA F-73, Horiba co. Ltd.) and found that the amount of flowing gas and the gas species did not influence the UFB concentration.

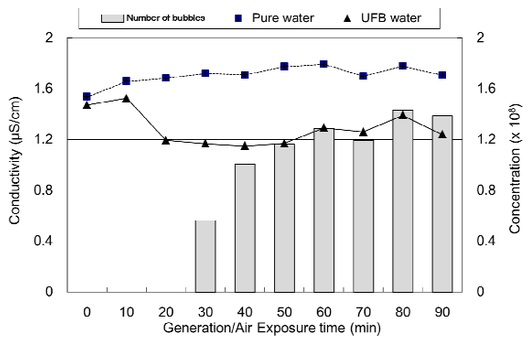

Figure 1. Comparison of electron conductivity between pure water and UFB water.

As depicted in Figure 1, we compared the electron conductivity and UFB concentration between pure water and UFB water, which is composed of pure water and air. We also measured the bubble concentration every 10 min in the bubble generator. In order to confirm the dissolution of natural air, we exposed the pure water to air and measured the electron conductivity every 10 min. We found that the conductivity of UFB water decreased in comparison to that of pure water.

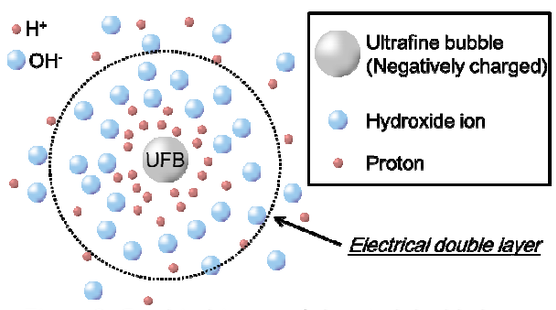

Figure 2. Graphical image of electrical double layer around UFB.

One possible explanation of this decrease is the localization of the protons and hydroxide ions on the stable bubbles in UFB water (Figure 2). UFB is negatively charged because of shearing process in the bubble generator. Protons are attracted by electric force with UFB and hydroxide ions are also approached around protons by means of electrical neutrality. Decrease of the conductivity suggested the existence of this electrical double layer and it also supported the stability of UFB for a long time. On the other hand, the pH values of pure water and UFB water did not differ; therefore, dissolution of carbon dioxide in the air has little influence on the conductivity.

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