

Claims

- [Claim 1] An ultrafine bubble generating method, comprising generating ultrafine bubbles by causing film boiling in liquid.
- [Claim 2] An ultrafine bubble generating method, comprising generating ultrafine bubbles in liquid by increasing a temperature of a surface of a heating portion provided inside liquid to 300°C or more and generating bubbles on the surface of the heating portion.
- [Claim 3] The ultrafine bubble generating method according to claim 1, wherein a heating portion in contact with liquid is provided, the film boiling is caused by heating the heating portion, and bubbles are generated on a surface of the heating portion.
- [Claim 4] The ultrafine bubble generating method according to claim 1 or 3, wherein the film boiling is caused intermittently.
- [Claim 5] The ultrafine bubble generating method according to any one of claims 1 to 4, wherein the ultrafine bubbles are generated from gas dissolved in liquid.
- [Claim 6] The ultrafine bubble generating method according to claim 2 or 3, wherein liquid contacts the heating portion in a shrinkage step after a growth process of the bubbles.
- [Claim 7] The ultrafine bubble generating method according to any one of claims 1 to 6, comprising a step of injecting gas into liquid.
- [Claim 8] The ultrafine bubble generating method according to claim 2 or 3, comprising a step of ejecting liquid from an ejection opening by using energy of bubbles generated on the surface of the heating portion.
- [Claim 9] The ultrafine bubble generating method according to claim 2 or 3, wherein a period during which liquid is heated by the heating portion is 100 μ sec or less.
- [Claim 10] The ultrafine bubble generating method according to claim 2 or 3, wherein an area of a surface of the heating portion in contact with liquid is 25.0 mm² or less.
- [Claim 11] An ultrafine bubble-containing liquid manufacturing apparatus, comprising:
a storage unit configured to store liquid in a position including a predetermined region; and
a heating unit configured to generate ultrafine bubbles in liquid by heating liquid in the predetermined region and causing film boiling.
- [Claim 12] The ultrafine bubble-containing liquid manufacturing apparatus

- according to claim 11, wherein the heating unit includes a heating resistance portion.
- [Claim 13] The ultrafine bubble-containing liquid manufacturing apparatus according to claim 11 or 12, further comprising a control unit configured to heat the heating unit intermittently to cause the film boiling intermittently.
- [Claim 14] The ultrafine bubble-containing liquid manufacturing apparatus according to any one of claims 11 to 13, further comprising a channel in which liquid flows through the predetermined region.
- [Claim 15] The ultrafine bubble-containing liquid manufacturing apparatus according to any one of claims 11 to 13, further comprising a circulation channel configured to circulate liquid through the predetermined region.
- [Claim 16] The ultrafine bubble-containing liquid manufacturing apparatus according to any one of claims 11 to 15, further comprising:
a pressure chamber including at least part of the predetermined region;
a supply channel for supplying liquid to the pressure chamber;
and
an ejection opening communicating with the pressure chamber,
wherein liquid inside the pressure chamber is ejected from the ejection opening by energy of bubbles generated by film boiling in liquid.
- [Claim 17] The ultrafine bubble-containing liquid manufacturing apparatus according to claim 16, further comprising a collection unit configured to collect liquid ejected from the ejection opening.
- [Claim 18] The ultrafine bubble-containing liquid manufacturing apparatus according to any one of claims 11 to 17, further comprising an injection unit configured to inject gas into liquid.
- [Claim 19] An ultrafine bubble-containing liquid manufacturing method, comprising:
a storage step of storing liquid in a position including a predetermined region; and
a heating step of generating ultrafine bubbles in liquid by heating liquid in the predetermined region and causing film boiling.
- [Claim 20] An ultrafine bubble-containing liquid, wherein the number of ultrafine bubbles contained in liquid is 2.0 billion or more per ml.

- [Claim 21] The ultrafine bubble-containing liquid according to claim 20, wherein 50% or more of the ultrafine bubbles contained in the liquid have a diameter ranging from 10 nm to 400 nm.
- [Claim 22] The ultrafine bubble-containing liquid according to claim 20 or 21, wherein the ultrafine bubbles are reduced by 50% or less after a week.
- [Claim 23] The ultrafine bubble-containing liquid according to any one of claims 20 to 22, wherein the ultrafine bubbles including gas therein are contained in the liquid and the gas is thus contained in an amount equal to or greater than a saturation solubility of the gas dissolved in the liquid under atmospheric pressure.
- [Claim 24] The ultrafine bubble-containing liquid according to any one of claims 20 to 23, wherein the liquid includes water as a main ingredient.
- [Claim 25] The ultrafine bubble-containing liquid according to any one of claims 20 to 24, wherein the liquid includes an organic solvent.
- [Claim 26] The ultrafine bubble-containing liquid according to any one of claims 20 to 24, wherein the liquid includes a chlorine compound.
- [Claim 27] The ultrafine bubble-containing liquid according to any one of claims 20 to 24, wherein the liquid includes an electrolyte ion.
- [Claim 28] The ultrafine bubble-containing liquid according to any one of claims 20 to 26, wherein the ultrafine bubbles include therein a gas selected from the group consisting of hydrogen, helium, oxygen, nitrogen, methane, fluorine, neon, carbon dioxide, ozone, argon, chlorine, ethane, propane, air, and gaseous mixtures thereof.
- [Claim 29] An ultrafine bubble-containing liquid manufacturing apparatus used in an apparatus that makes use of ultrafine bubbles, the ultrafine bubble-containing liquid manufacturing apparatus comprising:
a liquid chamber configured to store liquid; and
a heating portion provided inside the liquid chamber and configured to generate ultrafine bubbles by heating liquid inside the liquid chamber and causing film boiling.
- [Claim 30] An ultrafine bubble generating method used in an apparatus that makes use of ultrafine bubbles, wherein
a liquid chamber configured to store liquid and a heating portion provided inside the liquid chamber are comprised, and
ultrafine bubbles are generated in liquid by increasing a temperature of a surface of the heating portion to 300°C or more and generating bubbles on the surface of the heating portion.
- [Claim 31] The ultrafine bubble generating method according to claim 30, wherein

a period during which liquid is heated by the heating portion is 100 μ sec or less.