CLAIMS

1. An ultrafine bubble generating method comprising:

(a) a generating step of generating ultrafine bubbles smaller than 1.0 μm in diameter by causing a heating element provided in a liquid to generate heat to generate film boiling on an interface between the liquid and the heating element; and

(b) a post-processing step of performing predetermined post-processing on an ultrafine bubble-containing liquid containing the ultrafine bubbles generated in the generating step, the post-processing step comprising:

(i) a removal processing to remove an impurity from the ultrafine bubble-containing liquid,

wherein the removal processing includes a first processing to remove an inorganic ion by using a cation exchange resin and the inorganic ion removed by the first processing contains a metal forming the heating element; and

wherein the removal processing includes a second processing to remove an organic substance by using a filtration filter with a mesh diameter of 1.0 μm or smaller; and

(ii) an increasing processing to increase a concentration of the ultrafine bubbles contained in the ultrafine bubble-containing liquid by generating ultrasound in the ultrafine bubble-containing liquid.

2. The ultrafine bubble generating method according to claim 1, wherein the inorganic ion removed by the first processing contains at least one selected from Si, AL, W, Pt, Pd, Ta, Fe, Cr, Ni, Ir, and Ru.

3. The ultrafine bubble generating method according to claim 1, wherein the organic substance to be removed by the second processing contains at least one selected from an organic compound containing silicon, siloxane, epoxy, and bacteria.

4. The ultrafine bubble generating method according to any one of claims 1 to 3, wherein the removal processing includes a third processing to remove an insoluble solid substance by using precipitation characteristics of the insoluble solid substance.

5. The ultrafine bubble generating method according to claim 1, wherein in the increasing processing, the concentration of the contained ultrafine bubbles is increased by applying focused ultrasound to the ultrafine bubble-containing liquid.

6. The ultrafine bubble generating method according to any one of claims 1 to 5, further comprising:

a dissolving step of dissolving any one of hydrogen, helium, oxygen, nitrogen, methane, fluorine, neon, carbon dioxide, ozone, argon, chlorine, ethane, propane, air, and a mixed gas containing these into the liquid to be supplied in the generating step,

wherein in the generating step, ultrafine bubbles containing inside thereof gas that is dissolved in the dissolving step are generated.

7. The ultrafine bubble generating method according to any one of claims 1 to 6, wherein the generating step is performed again after the post-processing step is performed.

8. The ultrafine bubble generating method according to any one of claims 1 to 7, further comprising:

a step of collecting the ultrafine bubble-containing liquid processed in the post-processing step.

9. An ultrafine bubble generating apparatus comprising:

a generating unit configured to generate ultrafine bubbles smaller than 1.0 μm in diameter by causing a heating element provided in a liquid to generate heat to generate film boiling on an interface between the liquid and the heating element; and

a post-processing unit configured to perform predetermined post-processing on an ultrafine bubble-containing liquid containing the ultrafine bubbles generated by the generating unit,

wherein the post-processing unit includesa removal unit including:

a first unit that removes an inorganic ion by using a cation exchange resin and the inorganic ion removed by the first unit contains a metal forming the heating element; and

a second unit that removes an organic substance by using a filtration filter with a mesh diameter of 1.0 μm or smaller; and

wherein the post-processing unit includes an increasing processing unit that increases a concentration of the ultrafine bubbles contained in the ultrafine bubble-containing liquid by generating ultrasound in the ultrafine bubble-containing liquid.

10. The ultrafine bubble generating apparatus according to claim 9, wherein the inorganic ion removed by the first unit contains at least one selected from Si, AL, W, Pt, Pd, Ta, Fe, Cr, Ni, Ir, and Ru.

11. The ultrafine bubble generating apparatus according to claim 9, wherein the organic substance to be removed by the second unit contains at least one selected from an organic compound containing silicon, siloxane, epoxy, and bacteria.

12. The ultrafine bubble generating apparatus according to any one of claims 9 to 11, wherein the removal unit includes a third unit that removes an insoluble solid substance by using the precipitation characteristics of the insoluble solid substance.

13. The ultrafine bubble generating apparatus according to claim 9, wherein the increasing processing unit increases the concentration of the contained ultrafine bubbles by applying focused ultrasound to the ultrafine bubble-containing liquid.

14. The ultrafine bubble generating apparatus according to any one of claims 9 to 13, further comprising:

a dissolving unit that dissolves any one of hydrogen, helium, oxygen, nitrogen, methane, fluorine, neon, carbon dioxide, ozone, argon, chlorine, ethane, propane, air, and a mixed gas containing these into the liquid to be supplied to the generating unit,

wherein the generating unit generates ultrafine bubbles containing in the inside thereof the gas that is dissolved by the dissolving unit.

15. The ultrafine bubble generating apparatus according to any one of claims 9 to 14, further comprising:

a circulation route through which the liquid processed by the post-processing unit is supplied to the generating unit.

16. The ultrafine bubble generating apparatus according to any one of claims 9 to 15, further comprising:

a unit that collects the ultrafine bubble-containing liquid processed by the post-processing unit.