CLAIMS:

1. A method for treating water within a water system to control one or more of scaling, corrosion, bacteria and algae, the method comprising the steps of:

generating a superimposed time-varying frequency electromagnetic wave in which an AC driving signal with time-varying frequency is riding on a DC output with a predefined DC bias voltage to provide a DC superimposed time-varying AC pulsating ionic wave current,

transmitting the DC superimposed time-varying AC pulsating ionic wave current to one or more emitters placed in the water or in both the water and the water system,

subjecting the water and the water system to the generated DC superimposed time-varying AC pulsating ionic wave current so as to excite the water or both the water and the water system,

wherein the predefined DC bias voltage is set to be variable or fixed and the excitation causes a flow of ionic current having a DC component travelling in a pulsating and time-varying manner in the water or in both the water and the water system and induces vibration of electrons and molecules of the water or of both the water and the water system.

2. The method as claimed in claim 1 , wherein the DC output is generated by a DC biasing unit selected from the group consisting of switch mode DC power supply, an AC to DC converter, a rechargeable DC battery, and an inductive diode filter.

3. The method as claimed in any one of the preceding claims, wherein the generating step comprises configuring the superimposed time-varying frequency electromagnetic wave to have polar asymmetry or become a unidirectional pulsating wave.

4. The method as claimed in any one of the preceding claims, wherein the generating step comprises configuring the superimposed time-varying frequency electromagnetic wave to have half-wave distortion or full-wave distortion.

5. The method as claimed in any one of the preceding claims, wherein the frequency of the superimposed time-varying frequency electromagnetic wave is between about 100 Hz and about 1 MHz.

6. The method as claimed in claim 5, wherein the frequency of the superimposed time-varying frequency electromagnetic wave is between about 500 Hz and about 200 KHz.

7. The method as claimed in any one of the preceding claims, wherein the superimposed time-varying frequency electromagnetic wave has a sweeping frequency between about 1 Hz and about 1 KHz.

8. The method as claimed in claim 7, wherein the superimposed time-varying frequency electromagnetic wave has a sweeping frequency between about 10 Hz and about 500 Hz.

9. The method as claimed in any one of the preceding claims, wherein the generated time-varying superimposed DC pulsating ionic wave current is a biased alternating DC current having fixed frequency, time-varying frequency or random.

10. The method as claimed in any one of the preceding claims, wherein the generated DC superimposed time-varying AC pulsating ionic wave current is a biased alternating DC current having an alternating frequency of 1/100 to 1000 Hz.

11. The method as claimed in any one of the preceding claims, wherein the ionic current strength in the water is $\geq$ 0.1 amps.

12. The method as claimed in claim 11, wherein the ionic current strength in the water is $\geq$ 0.5 amps.

13. The method as claimed in any one of the preceding claims, wherein the water system comprises a metallic housing and the DC superimposed time-varying AC pulsating ionic wave current is controlled to flow in the water and the housing and form a magnetite layer on the surface of the housing.

14. The method as claimed in any one of the preceding claims, wherein the DC superimposed time-varying AC pulsating ionic wave current is controlled to flow in the water and cause precipitation of calcium carbonate and/or silica in the water.

15. The method as claimed in any one of the preceding claims, further comprising the step of controlling a negative return current of the DC superimposed time-varying AC pulsating ionic wave from the water system, the water system being a metallic structure, such that the DC superimposed time-varying AC pulsating ionic wave is distributed across the metallic structure surface and directly excites a target region of the metallic structure, and the excitation induces a flow of ionic current having a DC component travelling in a pulsating and time-varying manner in the target region and effects induced vibration of electrons and molecules in the target region.

16. A system for treating water within a water system to control one or more of scaling, corrosion, bacteria and algae, the system comprising:

a device for generating a superimposed time-varying frequency electromagnetic wave and having at least two output terminals, the device comprising an alternating current (AC) wave generator for generating an AC driving signal of AC electromagnetic wave having a time-varying frequency at a desired sweeping time, and a direct current (DC) biasing unit electrically coupled in series with the AC wave generator and for producing a DC output with a predefined DC bias voltage, the DC biasing unit being configured such that the DC output is mixed with the AC driving signal to produce a DC superimposed time-varying AC pulsating ionic wave current in which the time-varying frequency AC wave is riding on the predefined DC bias voltage and the DC bias voltage is controlled to vary continuously or in steps and at less than a peak voltage of the AC driving signal, and

an emitter provided at one or each of both of a first excitation site and a second excitation site in the water or in both the water and the water system and electrically coupled in series with the at least two output terminals of the device,

wherein the device is electrically coupled in series with the first excitation site and the second excitation site of the water or of both the water and the water system directly or through the emitter, such that the DC superimposed time-varying AC pulsating ionic wave current is applied to the water or to both the water and the water system, and

the DC bias output and the AC driving signal are superimposed such that the superimposed time-varying frequency electromagnetic wave is able to induce a flow of ionic current having a DC component travelling in a pulsating and time-varying manner in the water or in both the water and the water system and effect induced vibration of electrons and molecules of the water or of both the water and the water system.

17. The system as claimed in claim 16, wherein the DC biasing unit is selected from the group consisting of switch mode DC power supply, an AC to DC converter, a rechargeable DC battery and an inductive diode filter.

18. The system as claimed in any one of claims 16 to 17, wherein the water system comprises a housing which is metallic or non-metallic.

19. The system as claimed in any one of claims 16 to 17, wherein the housing is made of an electrically non-conductive material, and if the first and/or second excitation sites are positioned on the electrically non-conductive substrate, the emitter is provided at the respective excitation site to be electrically coupled with the device.

20. The system as claimed in any one of claims 16 to 19, wherein both the first and second excitation sites are positioned on the water system or in the water in a spaced relation, or one of the first and second excitation sites is positioned on the water system, and the other is positioned in the water.

21. The system as claimed in any one of claims 16 to 20, wherein the AC wave generator comprises a control unit configured to generate a signal having the time-varying frequency at the desired sweeping time, and one or more bridge-type circuit coupled to the control unit for receiving the signal generated from the control unit, the bridge-type circuit being driven by the received signal to generate and amplify the AC driving signal of the time-varying frequency AC electromagnetic wave, wherein the bridge-type circuit is configured to comprise one or more half-bridge driver integrated circuits (ICs) and one or more Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) coupled to the respective half-bridge driver ICs.

22. The system as claimed in any one of claims 16 to 21, wherein the control unit comprises a programmable integrated circuit (IC) for time-varying the frequency of the AC driving signal, and optionally a stabilizer circuit for stabilizing the AC driving signal.