CLAIMS

1. A method for preventing corrosion of at least one metallic structure in an electrolyte medium, comprising applying a superimposed time-varying frequency electromagnetic wave to the structure, the method comprising the steps of:

generating the superimposed time-varying frequency electromagnetic wave (DAC wave) in which an AC driving signal with time-varying frequency is riding on a DC output with a predefined DC bias voltage,

transmitting the DAC wave current to one or more emitters placed in the electrolyte medium,

emitting the DAC wave via the one or more emitters,

placing the one or more emitters at a spaced distance from the metallic structure,

subjecting the metallic structure to the DAC wave current, and

controlling the negative return current of the DAC wave from the metallic structure such that the DAC wave is distributed across the structure surface and directly excites a target region of the metallic structure, wherein 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 and the structure electrolyte potential distribution is controlled by regulating the negative return current of the DAC wave by means of variable resistors/impedances.

2. The method of claim 1 wherein the electrolyte medium comprises at least one of seawater, fresh water, estuary water, soil, mud or concrete.

3. The method of claim 1 or claim 2 wherein the DAC wave excites the structure and forms a protective oxide layer over the structure.

4. The method of claim 3 wherein the structure comprises one or more of:

a steel material wherein the protective oxide layer comprises magnetite;

a copper material wherein the protective oxide layer comprises Cu_2O; and

a stainless steel material wherein the protective oxide layer comprises chromium oxide.

5. The method of claim 1 wherein the target region includes a remote end of the structure from the emitter.

6. The method of any one of the preceding claims wherein the structure is exposed to cyclic wet/dry conditions.

7. The method of claim 6 further including the step of wetting the structure during a dry cycle period.

8. The method of claim 7 wherein the structure is wetted by means of a spray or water flow.

9. The method of claim 4 including the further step, following formation of magnetite on the steel surface, of reversing the polarity of the emitter and the structure to reverse the current flow to remove calcareous deposits from the magnetite surface.

10. The method of any one of the preceding claims wherein the emitter or emitters are placed remotely from the metallic structure to maximize an even potential distribution across the structure.

11. The method of any one of claims 1 to 8 wherein the emitter or emitters are placed close to the metallic structure such that hot spot protection by the DAC wave is obtained.

12. The method of any one of claims 1 to 4 wherein the structure comprises different metallic materials and the emitter or emitters are placed at a selected position close to the structure to provide corrosion protection for each of the different materials.

13. The method of any one of claims 1 to 4 wherein the electrolyte medium adjacent the metallic structure comprises high resistivity soil, comprising providing a deep well through the soil to a stratum of low resistivity soil and putting one or more emitters in the low resistivity soil.

14. The method of any one of the preceding claims wherein the emitter output is regulated by use of the direct structure-to-electrolyte potential to provide a feedback signal.

15. The method of any one of the preceding claims wherein the DAC wave shifts the structure to electrolyte potential to be potentially more negative to mitigate corrosion

current from leaving structure surface including meeting a required minimum cathodic protection potential criterion.

16. A system for preventing corrosion of at least one metallic structure in an electrolyte medium, comprising applying a superimposed time-varying frequency electromagnetic wave to the structure, the system comprising:

a device for generating the superimposed time-varying frequency electromagnetic wave (DAC 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 an 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 the superimposed time-varying frequency electromagnetic wave in which the time-varying frequency AC wave is riding on the predefined DC bias voltage;

one or more emitters connected to an output terminal of the device and spaced apart from the metallic structure; and

at least one negative current return connection provided on the metallic structure and connected to the other terminal of the device,

wherein the one or more emitters transmit the DAC wave to the metallic structure and the DAC wave is distributed across the structure surface and directly excites the metallic structure at a target region,

wherein the DC bias output and the AC driving signal are superimposed such that the DAC wave is able to induce a flow of ionic current having a DC component traveling in a pulsating and time-varying manner in the target region and effect induced vibration of electrons and molecules in the target region, and

wherein the structure electrolyte potential distribution is controlled by regulating the DAC negative return current by means of variable resistors/impedances.

17. The system of claim 16 wherein the DAC wave excites the structure and forms a protective oxide layer over the structure.

18. The system of claim 16 or 17 wherein the structure comprises one or more of:

a steel material wherein the protective oxide layer comprises magnetite;

a copper material wherein the protective oxide layer comprises Cu_2O; and

a stainless steel material wherein the protective oxide layer comprises chromium oxide.

19. The system of any one of claims 16 to 18 wherein the emitter or emitters are placed remotely from the metallic structure to maximize an even potential distribution across the structure.

20. The system of any one of claims 16 to 18 wherein the emitter or emitters are placed close to the metallic structure such that hot spot protection by the DAC wave is obtained.