Detection of Magnetization of 6 Hz, 10 µT Magnetic Field Applied Water Using PT-MI Sensor

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Abstract—We constructed an extremely sensitive magnetic sensor having one pico-Tesla resolution using single amorphous wire core CMOS IC magneto-impedance sensor with dc selective negative feedback circuitry (“pT-MI sensor”) for detection of the water magnetization. The water magnetization \( M \) is measured using a pendulum oscillation sample magnetic measurement method, in which a water sample bottle of 100 ml oscillates as a pendulum with 1.5 Hz in front of the pT-MI sensor head at 50 mm apart position showing 3 Hz magnetic field sinusoidal wave. Sample water (purified water and tap water) with 6 Hz, 10 µT magnetic field application through more than 1 hour showed a clear 3 Hz sinusoidal wave output of around 1 nT amplitude (\( M = 2.3 \text{ pT} \)) during at least 30 min. and not for samples without ac magnetic field application and also magnet dc field application. Mechanism of water magnetization has been proposed with an assumption of the cyclotron resonance of the water cluster \( \text{H}_3\text{O}^+ (\text{H}_2\text{O})_n \) which activates the proton transport in water under the geo-magnetic field (“magneto-protonics”).

1. INTRODUCTION

Possibility of magnetization of water has been discussed for a long time, which may change the water structure and reinforce the water function on physical and bio-chemical operations. A comprehensive investigation paper on the dc magnetization of water has recently been reported by X. F. Pang and Bo Deng [1] gathering the spectra of infrared, Raman, visible, ultraviolet lights and X-ray, in which the intensity of light absorption is higher in the dc magnetized water.

We represent measured results for the magnetization of water after application of a ultra-low frequency (6 Hz) small magnetic field superimposed with the geo-magnetic field using a newly constituted pico-Tesla resolution magneto-impedance sensor (“pT-MI sensor”). A double frequency sinusoidal magnetic field of around 1 nano-Tesla amplitude is detected when a 200 ml bottle with 100 ml magnetized water (purified water and public tap water) is pendulum type oscillated in a vertical plane at 5 cm apart from the pT-MI sensor head. The magnetization of the ac magnetized water under the geo-magnetic field is estimated as around 2.3 pT. No magnetization was detected for water samples without application of ac magnetic field or after application of dc magnetic field using NdFeB magnets. The magnetization mechanism resulting the long-range proton transport (“proton activation”) in ac magnetized water is explained using a model of cyclotron resonance of water clusters \( \text{H}_3\text{O}^+ (\text{H}_2\text{O})_n \), \( n = 0, 1, 2, \ldots \) under the geo-magnetic field (“magneto-protonics”).

2. PT-MI SENSOR

An extremely sensitive magnetic field sensor is needed to detect the magnetization of magnetized water. We newly constructed a pico-Tesla resolution ac magnetic sensor as illustrated in Figure 1 on the basis of the amorphous wire & CMOS IC magneto-impedance sensor (MI sensor) [2–5] by suppressing both the magnetic noises in the sensor head using an amorphous wire and the electronic circuit noises introducing the notch filters and a dc negative feedback circuitry. A tension annealed zero-magnetostrictive FeCoSiB amorphous wire of 30 µm diameter and 10 mm length (made by UNITIKA LTD.) with coil windings of 600 and 200 turns is used as the sensor head. The frequency response of the pT-MI sensor is set as 0.5 ~ 15 Hz.

3. MEASUREMENT OF MAGNETIZATION

Figure 2 represents measured results of magnetization of magnetized water at the room temperature using the pT-MI sensor without any magnetic shielding box. A 100 ml water is set in a plastic bottle
Figure 1: pT-MI sensor circuitry and magnetic field detection characteristics.

Figure 2: Oscillatory magnetic field waveforms of pendulum oscillated water samples 50 mm apart from the pT-MI sensor head. (a) Public distributing water (140Ω·m, 100 ml) 2 nT/div, 0.25 s/div. (b) 6 Hz, 10 μT pulse magnetic field, 3 hour applied public distributing water (140Ω·m, 100 ml) 2 nT/div, 0.25 s/div. (c) Purified water (8kΩ·m, 100 ml) 2 nT/div, 0.25 s/div. (d) 6 Hz, 10 μT pulse magnetic field, 3 hours applied purified water (8kΩ·m, 100 ml) 2 nT/div, 0.25 s/div.

of 60 mm diameter and 100 mm height hanged with a pair of 20 mm long strings and is oscillated as a pendulum with around 1.5 Hz in a vertical plane of 50 mm apart from the sensor head.

Only ac magnetized water samples ((b) and (d)) showed clear oscillatory double frequency (around 3 Hz) waveform for sample pendulum oscillation (around 1.5 Hz). That is, water (purified and tap water or public distributing water) is magnetized along the geomagnetic field after application of 6 Hz, 10 μT pulse magnetic field with few hours in the room temperature.

Water is also magnetized by application of pulse magnetic field with frequencies of 1 ∼ 60 Hz, 1 ∼ 100 μT through 10 min. to 20 hours. No magnetization is detected for water of as-prepared and dc magnetic field applied using magnets such as NdFeB through few hours. The magnetic moment m of the magnetized water center in the geomagnetic field is estimated using expressions as follows,

\[
H(r) = m \sin \theta / 4\pi\mu_0 r^3 \\
= \left( \frac{r_0^2 + 2\ell^2(1 - \cos \varphi)}{4\ell^2(1 - \cos \varphi)} \right)^{1/2} \\
\partial H = H(r_0) - H(r)
\]

where \(H(r)\) is a magnetic field along the vertically set sensor head, \(m\) the magnetic moment, \(\theta\) the angle of the geomagnetic field against vertical direction, \(\mu_0\) the vacuum permeability (\(4\pi \times 10^{-7} \text{ H/m}\)), \(r\) the distance between the center of water sample and the sensor head, \(\ell\) the pendulum length, \(\varphi\) the angle of pendulum string against the center of water sample and \(\partial H\) the amplitude of detected \(H\) for pendulum oscillation. Therefore, \(m = 2.3 \text{ pT}\).
Figure 3: Model for proton magnetic moment $M(H^+)$ alignment in cyclotron rotated clusters against the geomagnetic field $B_{dc}$ accompanied with the long range proton transport (dotted line).

Figure 4: Decreasing of the electric resistivity of purified water during application of 6 Hz, 10 $\mu$T pulse magnetic field through 20 hours at 24°C.

$$m^3 \text{ for } \mu_0 \partial H = 1 \text{nT}, r_0 = \ell = 8 \text{cm}, \text{ and } \theta = \varphi = \pi/4,$$

resulting the magnetization $M$ of the magnetized water is around 2.3 pT.

4. MAGNETO-PROTONICS

We have proposed a model for mechanism of the magnetization of water assuming cyclotron resonance of the water cluster $H_3O^+(H_2O)_n$, $n = 0, 1, 2, \ldots$ under the geo-magnetic field $B_{dc}$ with the cyclotron frequency $f_n = qB_{dc}/2\pi m_n$, $n = 0, 1, 2, \ldots$ ($q$: proton charge, $m_n$: mass of the water cluster) [6]. When an ac magnetic field with frequency $f_p$ ($n = p$) is applied to water, same sized water clusters with the mass of $m_p$ are gradually gathered each other due to the magnetic moment of the proton in each cluster which is inversely aligned to $B_{dc}$ direction during the cyclotron resonance with the proton rotation current. Forming of a domain of some water cluster strings is assumed during the cyclotron resonance as illustrated in Figure 3 in which each proton can transport to adjacent clusters (“long range ordered proton transport”) and decreases the electric resistivity of the magnetized water. Figure 4 represents measured results of the electric resistivity (inverse of the proton concentration; Proton Concentration Meter, EC/pH Meter WM-22EP, TOA DKK Co.) versus time characteristics in purified water at 24°C during application of 6 Hz, 10 $\mu$T pulse magnetic field. An exponential decreasing curve of the characteristics was resulted in which the resistivity decreased around 20% at 2 hours, 28% at 10 hours and 34% at 20 hours. Therefore, around 60% of the resistivity change occurs by application of 6 Hz magnetic field through 2 hours.

5. CONCLUSION

(1) Magnetization of magnetized water is measured using a pT-MI sensor.

(2) Water is magnetized by application of a ultra low frequency magnetic field through few hours in the geo-magnetic field.

(3) Magnetization of water is accompanied with the long range proton transport (proton activation) which is generated through the cyclotron resonance of water clusters in the geo-magnetic field (Magneto-Protonics model).

The proton activation reinforces the ATP production for mitochondria molecular motor operation in the bio cell (bio activation) and is useful for blood flow promotion in the human body, marine culture, plant culture, and industrial applications such as fuel cell activation.

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