

## Evaluation Methods of the Extended-Particle Water after Hydrogen Bond Dissociation

Sunao Sugihara\*

Shonan Institute of Technology, Fujisawa, Japan

\*Corresponding Author: Sunao Sugihara, Shonan Institute of Technology, Fujisawa, Japan.

Received: April 18, 2022; Published: April 23, 2022

DOI: 10.55162/MCMS.02.035

### Introduction

Water studies are widespread globally, and the methods are various kinds of technology. Some researchers study soft X-ray emission spectrometer [1], neutron diffraction [2], Raman scattering spectroscopy [3], Fourier transfer infrared spectra (FTIR) [4]. Those studies are mostly on H<sub>2</sub>O or any substance's compound with water. The contents are a structure like an angle of the O-H bond in the water molecule. Some interesting issues include hydrogen cation [5], Rydberg, and valence-shell character in H<sub>2</sub> [6].

On the other hand, they report the theoretical approaches using *Ab initio* calculations of the hydrogen bond [7] and density-functional theory exchange-correlation functions for hydrogen bonds in small water clusters [8]. We regard that the elucidation of macroscopic phenomena is essential from the viewpoints point of those theoretical approaches. We always put this stance on the excellent matching with theory and a piece of evidence in daily life when we treat water. Here we introduce techniques to research the water, although the detailed results of experiments have been published. Therefore, I will abbreviate some of them except for typical data with those instruments and principles.

### Methods

We analyzed the water to the relaxation time ( $T_2$ ) and free induction decay (FID) in H-NMR (R-90H, Hitachi Co. Ltd.). We compare the values of  $T_2$  (relaxation time) and FID (free induction decay) with those of the tap water, which is normal because we use the city water. And then, we estimate its smallness of it indirectly. The nature of the SIGN water is assumed to have characteristics in a pico-size ( $10^{-12}$  m). Moreover, we use Terahertz Time-Domain Spectroscopy (THz-TDS, Tohigi Nikon Co. Ltd.) and the Fourier-Transform Infrared spectroscopy (FT-IR 6000, JASCO) to confirm the transmittance of the terahertz wave (region of 0.6 to 20 THz) through the water since ordinary water usually absorbs the THz wave. Furthermore, we employ ORP (Oxidation Reduction Potential, Mother Tool, PH-230SD) to judge the reduction grade compared with tap water. Finally, we use ICP-AES (element analysis---SPS3000, Hitachi Co. Ltd.).

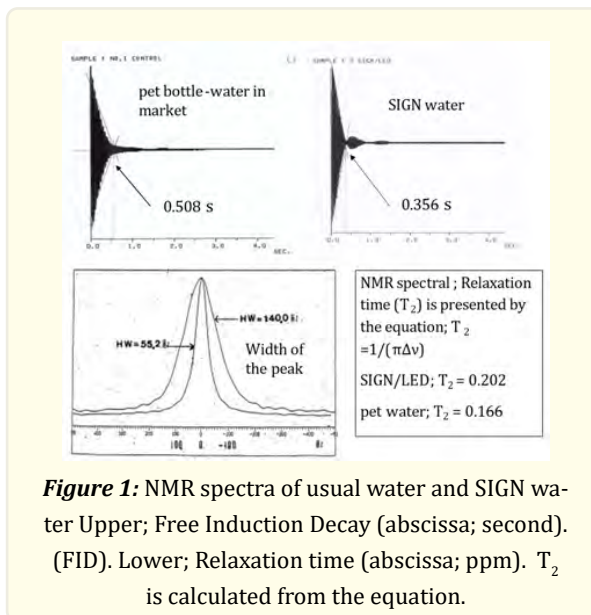
### Results and discussion

We presume that the water is the status of the extended particle, infoton  $\langle H^+ \sim e^- \rangle$ , which Sugihara named [9]. The particle forms after dissociating the hydrogen bonds among some water molecules pressurized under more than 100MPa. Namely, they are not an atom of hydrogen nor separated ions such as H<sup>+</sup> and e<sup>-</sup> oscillating between them. We explain the particle's quantum state by the computer simulation using the DV-X $\alpha$  method-- Discrete Variational-X $\alpha$  method [10]. Microscopically, the infoton possesses the properties of both electromagnetic waves to emit far-infrared through terahertz and elementary particle-like. The particle can function the transmutation in nuclear physics besides reducing chemistry due to possessing the characteristics of electromagnetic waves.

### H-NMR measurement

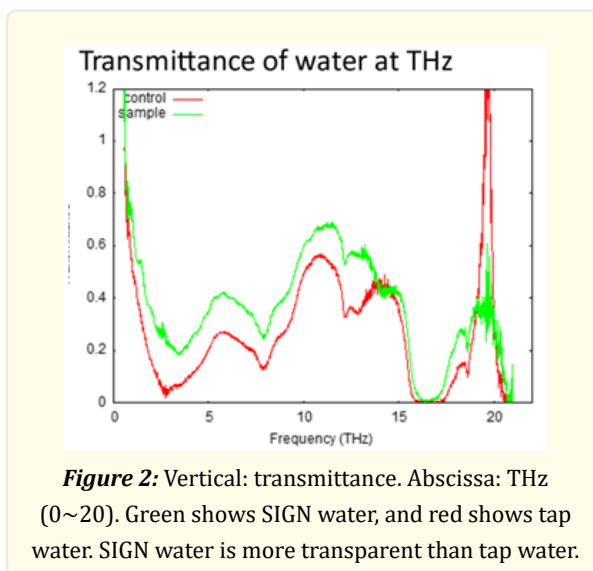
Firstly, it relates to the H-NMR method in which they reported the structure of water induced by specific ceramics treatment [11]. But, they did not measure relaxation time from the width of the spectra and free induction decay (FID) in the spectra, which are es-

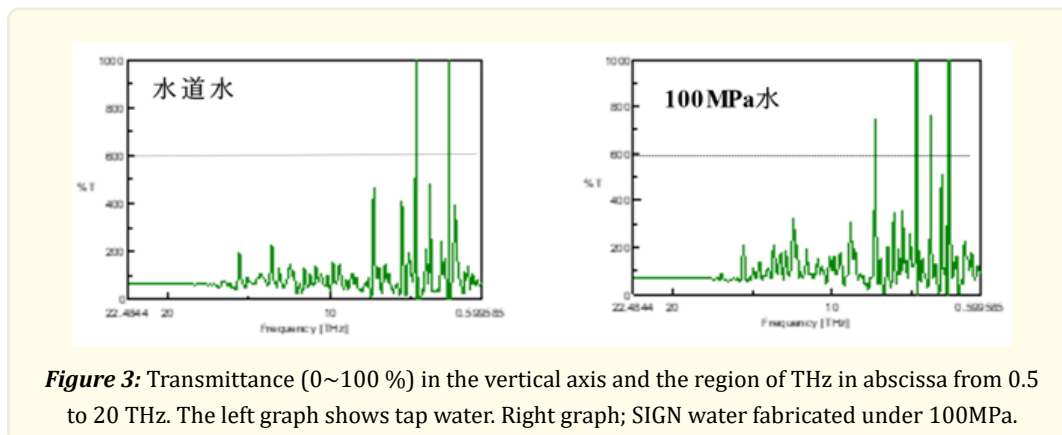
sentinal information implying the resonance of hydrogen in water. We can understand the difference between the SIGN water from tap water as described in Fig. 1.  $T_2$  indicates the time to the subsequent collision from a collision between the particles, in which longer time means smaller particles as compared in the same volume. Furthermore, a smaller FID value indicates a smaller particle of SIGN water because of the shorter time for which one particle resonates with standard hydrogen in H-NMR due to faster rotation.



**FT-IR measurement**

The following spectra describe the transmittance of an electromagnetic wave in the region of THz in Fig. 2.





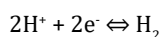
**Figure 3:** Transmittance (0~100 %) in the vertical axis and the region of THz in abscissa from 0.5 to 20 THz. The left graph shows tap water. Right graph; SIGN water fabricated under 100MPa.

Kumar et al. report hydrogen bonding in liquid water [12], in which they calculate the potential energy in water molecules by simulation. They discussed the orbital occupancies from the O-H and others' distances and angles. They concluded three H bonds per molecule which are stronger than others without any applications, and there is a similar report on the length and angle of O-H bonds [13]. The other study was related to photocatalyst to obtain hydrogen from water, using the solution of gallium and zinc nitrogen oxide,  $(\text{Ga}_{1-x}\text{Zn}) (\text{N}_{1-x}\text{O}_x)$  under visible light, 300~400nm [14], which is a one of photosynthesis.

#### **Oxidation-Reduction Potential measurement**

Many researchers reported oxidation-reduction potential covered by more expansive fields, so we abbreviate the citation, although here is a little different nuance.

Moving on to the oxidation-reduction potential [15], which means the grade is releasing (oxidized easier) or receiving (reductive easier) an electron from a substance. The following is the essential oxidation and reduction equation;



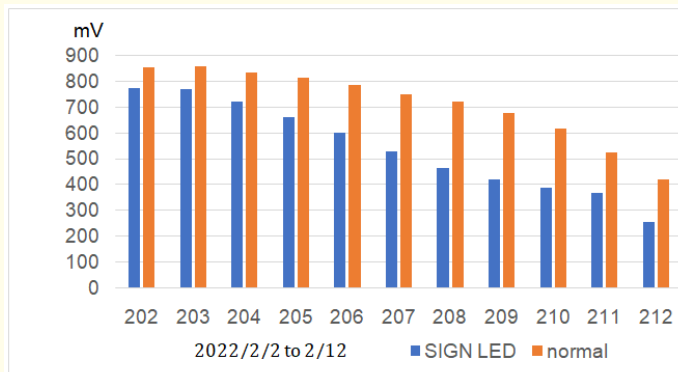
Here is the Nernst equation for the explanation of oxidation-reduction potential;

$$E = E^0 + \frac{RT}{F} \ln \frac{a_{\text{H}^+}}{(\text{p}_{\text{H}_2}/\text{p}^0)^{1/2}}$$

$E^0$ ; standard hydrogen electrode (V), R; gas constant ( $=8.3144\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$ ), T = Kelvin, F; Faraday constant ( $=9.64853 \times 10^4 \text{ C mol}^{-1}$ , aH<sup>+</sup>; hydrogen activity,  $\text{p}_{\text{H}_2}$ ; hydrogen partial pressure (Pa) and  $\text{p}^0$ ; standard hydrogen pressure ( $=101.3 \times 10^3 \text{ Pa}$ ) [16].

A numerator indicates the oxidized state, and a denominator shows the reductive form. Therefore, a minor E means the reductive state. One example suggests in Fig. 4.

The activated LED addresses the same function as SIGN water.



**Figure 4:** Reduction progresses for ten days when the activated LED illuminates tap water.

## Conclusion

We elucidated how we can judge the status of water after the dissociation of hydrogen bonds and what differences exist compared with tap water. We introduced three methods of H-NMR, FT-IR, and oxidation-reduction potential. According to these methods, we can notice that the tap water changes by SIGN water and the light (activated LED) treated with SIGN water. The macroscopic pieces of evidence in daily life were cited in the references if necessary.

## Acknowledgment

We express thankfulness to President Mr. Tomozi Matsubara for performing the oxidation reduction potential instrument.

## Reference

1. Riken, <http://www.riken.jp/r-world/info/release/press/2008>. (in Japanese).
2. Chialvo A, Cummings P and Cochran HD. "Interplay between molecular simulation and neutron scattering in developing new insights into the structure of water". *Industrial & Engineering Chemistry Research* (1998).
3. Hokkaido University Collection of Scholarly and Academic Papers: HUSCA. "Dynamical structure of water: Raman scattering spectroscopy".
4. Freda M., et al. "Transmittance Fourier Transform Infrared Spectra of Liquid Water in the Whole Mid-infrared Region: Temperature Dependence and Structural Analysis". *Applied Spectroscopy* 59-9 (2005): 1155-1159.
5. Sotiris SX. "Dances with hydrogen cations". *Nature* 457 (2009); 673-674.
6. Mulliken RS. "Rydberg and valence-shell character as functions of internuclear distance in some excited states of CH, NH, H<sub>2</sub>, and N<sub>2</sub>". *Chemical Physics Letters* 14 (1972): 141-144.
7. Barbiellini B and Shukla A. "Ab initio calculations of the hydrogen bond". *Physical Review B* 66.
8. Biswajit Santra, Angelos Michaelides and Matthias Scheffler. "On the accuracy of density-functional theory exchange-correlation functions for H bonds in small water cluster: Benchmarks approaching the complete basis set limit". *J. Chem.Phys* 127 (2007).
9. Sugihara S. infoton: Certificate of trademark registration No.5138668, Japan Patent Office (2008).
10. Sunao Sugihara, Takashi Igarashi, Chikashi Suzuki and Kenji Hatanaka. "Microscopic Approach to Water by Using the DV-X $\alpha$  Method, and Some Innovative Applications". *The DV-X $\alpha$ Molecular-Orbital Calculation Method* (eds. by T Ishii et al.) (Kagawa University), Switzerland: Springer International Publishing. Chapter 10 (2015): 257-89.
11. Kazushi SATO, Mariko AGO, Katsumi ISHIKAWA, Tsuneo SATO and Kunihiro OKAJIMA. "The Structure of Water Induced by Specific Ceramics Treatment and Effects of Treated Water in View of Some Biological Aspects". *Environ. Control Biol* 43.3 (2005): 211-221.

12. R Kumar, JR Schmidt and JL Skinner. "Hydrogen bonding definitions and dynamics in liquid water". *The Chem. Phys* 126 (2007):204107-3-12.
13. Scott JN and Vanderkooi JM. "A New Hydrogen Bond Angle/Distance Potential Energy Surface of the Quantum Water Dimmer". *Water* 2 (2010): 14-28.
14. Kazuhiko Maeda, Kentaro Teramura, Daling Lu, Tsuyoshi Takata, Nobuo Saito, Yasunobu Inoue and Kazunari Domen. "Photocatalyst releasing hydrogen from water". *Nature* 440 (2006): 295.
15. Kazuo HIGASHI, Yasushi YAMAMOTO and Hisao YOSHII. "The Effect of Oxidation-Reduction Potential on the Growth of the Salt-Tolerant Microorganisms; A study of Oxidation-Reduction Potential (Part I)". *J. Brew Soc. Japan* 80-4 (1985): 270-273.
16. Sunao Sugihara, Hiroshi Maiwa and Kunihiko Hatanaka. "Reduction and Relief of Cancer using Activated Light Emitting Diode". *Medicon Medical Sciences* 2.4 (2022): 11-20.

**Volume 2 Issue 5 May 2022**

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