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Liquid Water Molecule Deposited Energy below 0°C

Janez Špringer

Cankarjeva cesta 2, 9250 Gornja Radgona, Slovenia, EU

Corresponding Author:** ***Janez Špringer, *Cankarjeva cesta 2, 9250 Gornja Radgona, Slovenia, EU*

Abstract: *Respecting zero water molecule enthalpy of transformation and double-surface geometry the quantized water molecule deposited energies in the temperature interval ranged from -273.15 °C to 0°C are calculated and compared to that one belonging to 100°C. Enough high relative deposited energy could enable a zero-order desorption kinetics of water laid on solid surfaces.*

Keywords: *double-surface geometry, zero enthalpy of transformation, relative deposited energy, water desorption, zero desorption kinetics*

1. PREFACE

Previously the deposited energies of water molecule from 0°C to 100°C were calculated [1]. In the present paper using the same technique [1]the deposited energies in the interval ranged from -273.15°C to 0°C are the central subject of interest.

2. THE TEMPERATURE DEPENDENT INITIAL ORBITS

The next temperature dependence expressed in Celsius degrees is expected for the initial non-bound Oxygen electron orbit length [1]:

$$s_0 = s(121) + \frac{s(123) - s(121)}{100°C}\, x\, T = 121.040\,763 + 0.019\,993\, x\, \frac{T}{°C}. \quad (1)$$

And for the initial bound Hydrogen electron orbit length we have [1]:

$$s_H = s(103.5) - \frac{s(103.5) - s(98)}{100°C}\, x\, T = 103.547\,646 - 0.054\,973\, x\, \frac{T}{°C}. \quad (2)$$

Where n and s(n) is the orbit number and orbit length, respectively, related as follows [1]:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1 + \frac{\pi^2}{n^2}}}\right). \quad (3)$$

The initial non-bound Oxygen electron orbit lengths from s(115) to s(123) and the initial bound Hydrogen electron orbit lengths from s(119) to s(98) then should occupy the next 47 temperature intervals ranged from -273.15°C to 100°C as presented in Table1:

Table1. *Temperature intervals of initial non-bound Oxygen and bound Hydrogen electron orbits from -273.15°C to 100°C*

Temperature interval number	Temperature interval T(°C)	Initial non-bound Oxygen electron orbit number	Initial bound Hydrogen electron orbit number
47	100,0 – 109,1	123	98
46	90.9 –100.0	122	98.5
45	81.8 – 90.9	122	99
44	72.7 – 81.8	122	99.5
43	63.6 – 72.7	122	100
42	54.5 – 63.6	122	100.5
41	50.0 – 54.5	122	101
40	45.5 – 50.0	121	101
39	36.4 – 45.5	121	101.5

38	27.3 – 36.4	121	102
37	18.2 – 27.3	121	102.5
36	9.1 – 18.2	121	103
35	0.0 – 9.1	121	103.5
34	(-9.1) – 0.0	120	104
33	(-18.2)– (-9.1)	120	104.5
32	(-27.3) – (-18.2)	120	105
31	(-36.4) – (-27.3)	120	105.5
30	(-45.5) – (-36.4)	120	106
29	(-50.0) – (-45.5)	120	106.5
28	(-54.5) – (-50.0)	119	106.5
27	(-63.6) – (-54.5)	119	107
26	(-72.7) – (-63.6)	119	107.5
25	(-81.8) – (-72.7)	119	108
24	(-90.9) – (-81.8)	119	108.5
23	(-100.0) –(-90.9)	119	109
22	(-109.1) –(-100.0)	118	109.5
21	(-118.2)– (-109.1)	118	110
20	(-127.3) – (-118.2)	118	110.5
19	(-136.4) – (-127.3)	118	111
18	(-145.5) – (-136.4)	118	111.5
17	(-150.0) – (-145.5)	118	112
16	(-154.5) – (-150.0)	117	112
15	(-163.6) – (-154.5)	117	112.5
14	(-172.7) – (-163.6)	117	113
13	(-181.8) – (-172.7)	117	113.5
12	(-190.9) – (-181.8)	117	114
11	(-200.0) – (-190.9)	117	114.5
10	(-209.1) – (-200.0)	116	115
9	(-218.2)– (-209.1)	116	115.5
8	(-227.3) – (-218.2)	116	116
7	(-236.4) – (-227.3)	116	116.5
6	(-245.5) – (-236.4)	116	117
5	(-250.0) – (-245.5)	116	117.5
4	(-254.5) – (-250.0)	115	117.5
3	(-263.6) – (-254.5)	115	118
2	(-272.7) – (-263.6)	115	118.5
1	(-273.15)– (-272.7)	115	119

Each temperature interval should possess a characteristic deposited energy.

3. THE TEMPERATURE DEPENDENT DEPOSITED ENERGIES

Respecting the restrictions of step by step orbital energy exchange [1]the next temperature dependent liquid water molecule deposited energies are collected in Table2.

Table2. *Liquid water molecule deposited energies belonging to the temperature intervals ranged from -273.15°C to 100°C*

Temperature interval number	Temperature interval T(°C)	$E_{contraction}$ (eV)	$E_{extension}$ (eV)	$E_{average}$ (eV)	$\Delta E_{average}$ (eV)
47	100,0 – 109,1	2.74127	2.18537	2.46332	0.00000
46	90.9 –100.0	2.82015	2.43948	2.62982	0.16650
45	81.8 – 90.9	2.75736	2.12900	2.44318	-0.02014
44	72.7 – 81.8	2.97869	2.22092	2.59980	0.13648
43	63.6 – 72.7	3.08620	2.29050	2.68835	0.22503
42	54.5 – 63.6	3.00821	2.33603	2.67212	0.20881
41	50.0 – 54.5	2.94355	2.00150	2.47252	0.00920
40	45.5 – 50.0	3.13376	2.22141	2.67759	0.21427
39	36.4 – 45.5	3.25418	2.28628	2.77023	0.30691
38	27.3 – 36.4	3.22412	1.92987	2.57700	0.11368

37	18.2 – 27.3	3.34366	1.97432	2.65899	0.19567
36	9.1 – 18.2	3.31271	2.03154	2.67213	0.28081
35	0.0 – 9.1	3.43141	2.10421	2.76781	0.30449
34	(-9.1) – 0.0	3.58873	1.93856	2.76365	0.30033
33	(-18.2)– (-9.1)	3.52522	2.00908	2.76715	0.30383
32	(-27.3) – (-18.2)	3.67399	2.01891	2.84645	0.38313
31	(-36.4) – (-27.3)	3.60966	2.08703	2.84835	0.38503
30	(-45.5) – (-36.4)	3.75763	1.78079	2.76921	0.30589
29	(-50.0) – (-45.5)	3.69252	1.84599	2.76926	0.30594
28	(-54.5) – (-50.0)	3.91007	1.83444	2.87226	0.40894
27	(-63.6) – (-54.5)	3.84844	1.68410	2.76627	0.30295
26	(-72.7) – (-63.6)	3.99139	1.74777	2.86958	0.40626
25	(-81.8) – (-72.7)	3.92900	1.71572	2.82236	0.35904
24	(-90.9) – (-81.8)	4.07122	1.79219	2.93170	0.46838
23	(-100.0) – (-90.9)	4.00809	1.68159	2.84484	0.38152
22	(-109.1) –(-100.0)	4.18422	1.53032	2.85727	0.39395
21	(-118.2)– (-109.1)	4.16576	1.56160	2.86368	0.40036
20	(-127.3) – (-118.2)	4.29544	1.54842	2.92193	0.45861
19	(-136.4) – (-127.3)	4.24200	1.43181	2.83691	0.37359
18	(-145.5) – (-136.4)	4.33660	1.49627	2.91644	0.45312
17	(-150.0) – (-145.5)	4.31631	1.57476	2.94554	0.48222
16	(-154.5) – (-150.0)	4.44436	1.32191	2.88313	0.41981
15	(-163.6) – (-154.5)	4.27567	1.38403	2.82985	0.36653
14	**(-172.7) – (-163.6)**	**4,52528**	**1.45117**	**2.98823**	**0.52491**
13	(-181.8) – (-172.7)	4.46139	1.37239	2.91689	0.45357
12	(-190.9) – (-181.8)	4.58668	1.08803	2.83736	0.37404
11	(-200.0) – (-190.9)	4.53289	0,99955	2.76622	0.30290
10	(-209.1) –(-200.0)	4.92828	0.95564	2.94196	0.47864
9	(-218.2)– (-209.1)	4.76681	1.01892	2.89287	0.42955
8	**(-227.3) – (-218.2)**	**4.99250**	**1.08303**	**3.03776**	**0.57444**
7	(-236.4) – (-227.3)	4.83335	1.00433	2.91884	0.45552
6	**(-245.5) – (-236.4)**	**5.04691**	**1.07219**	**3.05955**	**0.59623**
5	(-250.0) – (-245.5)	4,88871	0.95674	2.92272	0.45940
4	(-254.5) – (-250.0)	4.98500	1.01417	2.99958	0.53626
3	(-263.6) – (-254.5)	4.99577	1.07593	3.03585	0.57253
2	(-272.7) – (-263.6)	5.05915	0,99493	3,02704	0.56372
1	**(-273.15)– (-272.7)**	**5.05299**	**1.06052**	**3.05675**	**0.59343**

Interesting deposited energies are highlighted in the bold print.

4. THE TEMPERATURE DEPENDENT RELATIVE DEPOSITED ENERGIES

The deposited energies relative to the value belonging to 100 °C (relative deposited energies) are presented in Figure 1.

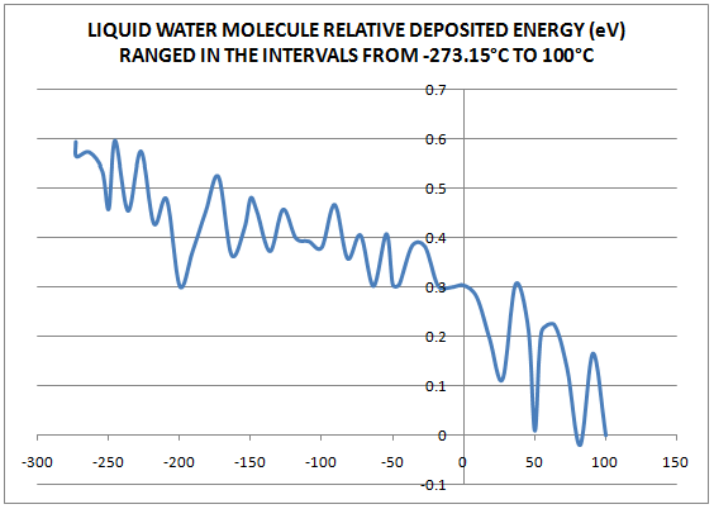

Figure1. *Liquid water molecule relative deposited energies*

We can see that the concerned relative deposited energy changes up and down around the trend to be lowered with the increasing temperature from the starting value of 0.59 eV possessed at -273.15 °C to the final zero value belonging to 100 °C.

5. RESULTS AND CONCLUSIONS

Interesting are the water molecule relative deposited energies belonging to the temperature intervals ranged from (-273.15°C to -272.7°C),(-245.5°C to -236.4°C) and (-227.3°C to -218.2°C) being comparable to the desorption energy of 0.58 eV of water molecule laid on hexagonal ice surface (Hobbs 1974). Besides, the relative deposited energy value of 0.52 eV achieved at the temperature interval of (-172.7°C to -163.6°C) surpassing the desorption energy of 0.47eV could explain a zero-order kinetics of water laid on a thin silica film at that temperature [2].

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Thanks God for Patience and Love

DEDICATION

This fragment was written on the occasion of the centenary of the connection of Prekmurje to the motherland of Slovenia and is dedicated to the Mura River - a living symbol of Connection

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