

# Anomalous gas emission from low-energy nuclear reaction of water

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Cavitation may induce low-energy nuclear reaction (LENR) through implosion of vapor bubbles [1]. We conducted experiments using two reactors made from multiple-pipe heat exchanger and found that the heat exchange process produces peculiar excess heat and nuclear transmutation [2]. Recently, we have tested another 8 reactors. Interestingly, these reactors also produced non-condensable gas.

Fourteen gas samples collected from the operating conditions with excess heat ( $COP_x > 1$ ) and without excess heat ( $COP_x = 1$ ) are analysed using mass spectrometry (MS). All ten gas samples from the performance having excess heat or LENR ( $COP_x > 1.05$ , considering experimental errors) contain abnormally strong signals at  $m/z$  22 and  $m/z$  44 peaks, whose  $Ra_{22}$  and  $Ra_{44}$  are larger than 1.5 (Table 1).  $Ra_{22}$  and  $Ra_{44}$  are defined as the signal ratio of the gas sample to the background air at  $m/z$  22 and  $m/z$  44, respectively. We take  $Ra_{22}$  and  $Ra_{44} > 1.5$  as the criterion to distinguish the presence of extra gases in addition to the background air, considering the errors of MS. The other four gas samples from the operating conditions  $COP_x < 1.05$  show normal results ( $Ra_{22}$  and  $Ra_{44} < 1.5$ ). However,  $Ra_{22}$  and  $Ra_{44}$  of Tube24 gas are extremely high, 60.9 and 78.4, respectively.  $Ra_{22}$  and  $Ra_{44}$  of Tube7, Tube8, and Tube14 also exceeded 6.0. Since  $CH_4$ ,  $NO_2$  and  $CO$  are impossible to present in LENR to interfere the  $m/z$  44 signal, the measured high  $m/z$  44 signal as well as  $Ra_{44}$  strongly suggests the presence of  $CO_2$ . High  $m/z$  22 signal and  $Ra_{22}$  also indicates the presence of  $^{22}Ne$ . We define a parameter  $G$  as

$$G = \frac{Ra_{42}(\text{gas})}{Ra_{42}(\text{air})} = \frac{m/z\ 44(\text{gas}) \div m/z\ 22(\text{gas})}{m/z\ 44(\text{air}) \div m/z\ 22(\text{air})}$$

It is found that the measured  $G$  values are all greater than 1.0 if LENR occurs or  $COP_x > 1.05$ . Using this empirical relationship  $G > 1$  and a model analyzing the interference of  $CO_2$  on  $m/z$  22 signal, it can be verified that LENR does produce  $^{22}Ne$ .

All the above evidence strongly suggests that the anomalous gas emission is generated from the LENR of water and contains  $^{22}Ne$  and  $CO_2$ .

Table 1 Analysis of non-condensable gases from LENR of water using mass spectrometry.

Gas sample ID	Tube6	Tube7	Tube8	Tube9	Tube10	Tube12	Tube13	Tube14	Tube 16	Tube 17	Tube 18	Tube 23	Tube 24	Tube 27
Gas source (Reactor)	VCS(SRT)	VCS(SRT)	VCS(SRT)	only boiler	VCS(SRT)	JT1-N3S	DHX-2B	JT4-BV	DHX-2B	VCS-NTU(c)	JT3-CV	nDHX-2B	VCS-NTU	JT5-A5
$Ra_{22} = m/z\ 22(\text{gas}) \div m/z\ 22(\text{air})$	1.50	<b>11.0</b>	<b>6.16</b>	<b>1.00</b>	1.66	<b>0.71</b>	2.26	<b>9.58</b>	1.77	<b>1.12</b>	1.68	2.14	<b>60.9</b>	<b>1.43</b>
$Ra_{44} = m/z\ 44(\text{gas}) \div m/z\ 44(\text{air})$	1.56	<b>12.6</b>	<b>7.00</b>	<b>0.94</b>	1.88	<b>0.39</b>	2.50	<b>13.0</b>	1.79	<b>1.09</b>	1.73	2.40	<b>78.4</b>	<b>1.37</b>
$R42(\text{gas}) = m/z\ 44(\text{gas}) \div m/z\ 22(\text{gas})$	75.0	85.8	82.9	72.1	64.5	40.1	71.4	78.6	89.1	85.7	90.5	95.7	109.8	81.5
$R42(\text{air}) = m/z\ 44(\text{air}) \div m/z\ 22(\text{air})$	72.2	75.1	73.0	77.1	57.1	72.9	64.5	57.9	88.0	88.0	88.0	85.3	85.3	85.3
<b>Relative ratio <math>G = R42(\text{gas}) \div R42(\text{air})</math></b>	1.04	1.14	1.14	<b>0.94</b>	1.13	<b>0.55</b>	1.11	1.36	1.01	<b>0.97</b>	1.03	1.12	1.29	<b>0.96</b>
<b><math>G &gt; 1</math></b>	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
$Ra_{22} > 1.5$	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
$Ra_{44} > 1.5$	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
LENR (with $COP_x > 1.05$ )	Y	Y	Y	n	Y	n	Y	Y	Y	n	Y	Y	Y	n
Measured $COP_x$	1.53	1.61	1.61	<b>1.0</b>	1.51	<b>1.02</b>	1.17	1.10	1.20	<b>1.02</b>	1.05	1.20	1.57	<b>1.03</b>

1) "air" denotes the background air; "gas" denotes the gas sample. 2) Tube9 gas is water vapor taken from a stem boiler directly. 3) The red marked figures are at conditions without LENR ( $COP_x < 1.05$ ). 4) Tube17 gas is from VCS-NTU under calibration test using controlled operating condition for  $COP_x = 1$ . 5)  $Ra_{22}$  and  $Ra_{44}$  of Tube7, Tube8 and Tube14 exceeding 6.0 and abnormally high for Tube24 all strongly suggests the presence of  $^{22}Ne$  and  $CO_2$  gases.

- [1] Bob Greenyer. Affordable ultrasonic driven transmutation? Martin Fleischmann Memorial Project, Oct 6, 2019. <http://www.quantumheat.org/index.php/en/home/mfmp-blog/552-ultra-affordable-ultrasonic-driven-transmutation>
- [2] Bin-Juine Huang, Ming-Li Tso, Ying-Hung Liu, Jong-Fu Yeh, I-Fee Chen, Yu-Hsiang Pan, Ching-Kang Huang, Mou-Yung Liao, Yi-Chun Chen, Po-Hsien Wu. Excess Energy from Heat-Exchange Systems. *J. Condensed Matter Nucl. Sci.* 36 (2022) 247–265