International Journal of Advanced Research in Physical Science (IJARPS)
Volume 8, Issue 7, 2021, PP 1-3
ISSN No. (Online) 2349-7882
www.arcjournals.org

Bromine Speed at Translationally Cold Circumstances

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Abstract: *For both bromine isotopes the difference between molecule and atom alignment energy has been calculated and compared with the kinetic energy of the bromine atoms formed by the molecule splitting at translationally cold circumstances.*

Keywords: *bromine alignment energy, bromine kinetic energy and speed, translationally cold circumstances*

1. Introduction

Let us calculate the difference between molecule and atom alignment energy and compare it with the kinetic energy of the bromine atoms formed by the molecule splitting at translationally cold circumstances.

2. The Alignment Energy

The alignment energy of the atom or molecule enables the alignment of the electron with its atom or molecule nature [1], [2], [3], [4],[5]. It is given by the next formula:

$$Wk_{alignment} = \left(\frac{R_{unaligned}}{R_{aligned}} - 1\right) m_{electron}^{rest} c^2. \tag{1}$$

Where $R_{unaligned}$ is the unaligned modified ratio of atom or molecule mass to electron mass:

$$R_{unaligned} = \frac{m_{atom\ or\ molecule}}{m_{electron}^{rest}} s(1). \tag{2}$$

The factor $s(1) = 1{,}696\ 685\ 529\ldots$ is the average elliptic-hyperbolic manifestation of one (n = 1) elliptic Compton wavelength of the electron given by the next equation:

$$s(n) = n\left(2 - \frac{1}{\sqrt{1+\frac{\pi^2}{n^2}}}\right), n \in \mathbb{N}. \tag{3}$$

And the aligned modified ratio $R_{aligned}$ is given by the same equation (3) for the down rounded unaligned modified ratio ($n = ROUNDDOWN\ (R_{unaligned})$) as follows:

$$R_{aligned} = s\left(\text{ROUNDOWN}\left(R_{unaligned}\right)\right). \tag{4}$$

3. The Bromine Alignment Energy

Using the data from the reference [6], [7] and applying the equations (1), (2), (3), (4) the alignment energies of the bromine isotopes ^{79}Br and ^{81}Br as well as corresponding molecules $^{79}Br_2$ and $^{81}Br_2$ have been calculated. The bromine alignment characteristics are presented in Table 1.

Table1. *The alignment characteristics of bromine isotopes* ^{79}Br *and* ^{81}Br *as well as of corresponding molecules* ^{79}Br$_2$ *and* ^{81}Br$_2$

Bromine	Mass (Da)	Unaligned R	Aligned R	Alignment energy (eV)	Alignment energy difference (eV)
^{79}Br	78,918336	244084,0367	244082,00002	0,076795928	

$^{79}Br_2$	157,836672	488168,0734	488168,00001	0,076827673	0,0000317448
^{81}Br	80,916290	250263,4457	244085,00002	0,910061165	
$^{81}Br_2$	161,832580	500526,8914	500526,00001	0,910091362	0,0000301967
e^-	0,00054857990907				

We can see in Table 1 that the alignment energy of the bromine molecule Br_2 is a little greater than that of the bromine atom Br. The statement is valid for both isotopes ^{79}Br and ^{81}Br as follows:

$$\Delta W_{alignment}^{Br2-Br} = W_{alignment}^{Br2} - W_{alignment}^{Br} > 0. \tag{5}$$

4. THE BROMINE SPLITTING

When a bromine molecule Br_2 splits into two bromine atoms $Br + Br$, the alignment energy difference $\Delta W_{alignment}^{Br2-Br}$ should be released:

$$Br_2 \to Br + Br + \Delta W_{alignment}^{Br2-Br}. \tag{6}$$

If the released energy is in the form of kinetic energy each bromine atom can fraternally take half of it:

$$W_{kinetic}^{Br} = \frac{1}{2}\Delta W_{alignment}^{Br2-Br}. \tag{7}$$

For the lighter isotope ^{79}Br a slightly greater kinetic energy is expected:

$$W_{kinetic}^{Br(79)} = \frac{0{,}000\ 031\ 7448\ \text{eV}}{2} > W_{kinetic}^{Br(81)} = \frac{0{,}000\ 030\ 1967\text{eV}}{2}. \tag{8}$$

At translationally cold circumstances (T<1 K) the received kinetic energy $W_{kinetic}^{Br}$ (7), (8) is at the same time the total kinetic energy per bromine atom.

5. THE BROMINE SPEED AT TRANSLATIONALLY COLD CIRCUMSTANCES

The received kinetic energy is reflected in the speed of the atom. If the speed is both translational and rotational, it depends on both the mass of the atom and the moment of inertia of the atom. The following speed applies to an atom as a rolling homogeneous sphere (See appendix):

$$v_{homogeneous\ sphere} = \sqrt{\frac{10}{7}}\sqrt{\frac{W_{kinetic}}{m_{homogeneous\ sphere}}}. \tag{9}$$

Inserting in the above equation (9) the kinetic energy of bromine atom (8) expressed in joules as well as the atom mass (Table 1) expressed in kilograms the next speeds of bromine isotopes ^{79}Br and ^{81}Br at translationally cold circumstances are given:

$$v_{Br^{79}} = \sqrt{\frac{10}{7}}\sqrt{\frac{\frac{0{,}000\ 031\ 744\ 8\ \text{eV}}{2} x\ 1{,}602\ 176\ 634\ x\ 10^{-19}\frac{J}{eV}}{78{,}918\ 336\ \text{Da x}\ 1{,}660\ 539\ 04\ \text{x}\ 10^{-27}\frac{kg}{Da}}} = 5{,}27\ ms^{-1}. \tag{10a}$$

And

$$v_{Br^{81}} = \sqrt{\frac{10}{7}}\sqrt{\frac{\frac{0{,}000\ 030\ 196\ 7\ \text{eV}}{2} x\ 1{,}602\ 176\ 634\ x\ 10^{-19}\frac{J}{eV}}{80{,}916\ 290\ \text{Da x}\ 1{,}660\ 539\ 04\ \text{x}\ 10^{-27}\frac{kg}{Da}}} = 5{,}07\ ms^{-1}. \tag{10b}$$

6. CONCLUSION

The given result is in accordance with the measured speed of < 5ms^{-1} presented in reference [8]. After all, heterogeneous or somehow deformed physical bodies should be slightly slower.

DEDICATION

This fragment is dedicated to the Assumption of Mary and the footprints in the sand. Sunday, August 15, 2021

Figure1. *Sunday, August 15, 2021*

REFERENCES

[1] Janez Špringer (2021). Whole and Part in Hydrogen Atom. International Journal of Advanced Research in Physical Science (IJARPS) 8(5), pp.1-3, 2021.

[2] Janez Špringer (2021). Whole and Part in Helium. International Journal of Advanced Research in Physical Science (IJARPS) 8(5), pp.4-8, 2021.

[3] Janez Špringer (2021). Gap Energy in Hydrogen and Helium. International Journal of Advanced Research in Physical Science (IJARPS) 8(5), pp.12-15, 2021

[4] Janez Špringer (2021). Gold Gap Energy. International Journal of Advanced Research in Physical Science (IJARPS) 8(6), pp.1-3, 2021.

[5] Janez Špringer (2021). Oxygen Alignment Energy at Water Splitting. International Journal of Advanced Research in Physical Science (IJARPS) 8(6), pp.10-12, 2021.

[6] CODATA, retrieved July 2021

[7] Exact Masses of the Elements, Isotopic Abundances of Elements (sisweb.com), retrieved July 2021

[8] Doherty WG, Bell MT, Softley TP, Rowland A, Wrede E, Carty D. Production of cold bromine atoms at zero mean velocity by photodissociation. Phys Chem Chem Phys. 2011 May 14;13(18):8441-7. doi: 10.1039/c0cp02472d. Epub 2011 Feb 28. PMID: 21359358.

APPENDIX

For a rolling body, it holds:

$$W_{kinetic} = \frac{mv^2}{2} + \frac{J\omega^2}{2}, \omega = \frac{v}{r}. \qquad (a)$$

For a homogeneous rolling sphere, it holds:

$$J = \frac{mr^2}{2{,}5}. \qquad (b)$$

Inserting (b) in (a) we have:

$$W_{kinetic} = \frac{mv^2}{2} + \frac{\frac{mr^2}{2{,}5}\frac{v^2}{r^2}}{2} = \frac{mv^2}{2} + \frac{mv^2}{5}. \qquad (c)$$

And explicitly for speed the next relation is given:

$$v = \sqrt{\frac{10}{7}}\sqrt{\frac{W_{kinetic}}{m}}. \qquad (d)$$

Citation: *Janez Špringer (2021). Oxygen Alignment Energy at Water Splitting. International Journal of Advanced Research in Physical Science (IJARPS) 8(7), pp.1-3, 2021.*