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Pseudocoulombic Force or Molecular Binding Force.

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Abstract

According to the present proposition the electrons are not point particles gravitating around the nucleus like planets around the sun, but that in an atom with several electrons the latter encircle the nucleus like e.g., onionskins [1]. This arrangement gives the atoms and molecules a spherical structure occupying a real volume. It is moreover Rocard's interpretation, which admits that the molecules must be considered as rigid and elastic spheres for the calculation of intermolecular forces [2].

Keywords: Theoretical Physics of Atom, Mechanics of Atom, Electrical Charge of Electron, Binding Force, Electromagnetic Radiation, Molecular Binding

Introduction

The fusion of particles to form an atom is accompanied by the emission of part of the charge of the atom's outer electrons. Thus, the charge of the outer electron is always inferior to the normal charge es which is the threshold charge allowing the repulsive coulombic interaction. Under certain conditions the electric charge of the outer electron will even be quite insufficient and the electron will try to complete its charge by attracting similar neighboring charges. This avidity can only be satisfied at the cost of the incident radiation if the electron belongs to an external atom of a solid structure or at the cost of the neighboring atoms if the atom is inside this structure. The weaker the charge of the electron, the greater will be the force clinging to the other atoms in order to make-up the deficit. It is obvious that in a solid structure the neighboring atoms are in the same state of shortage and that they won't let go their charges. It is this charge shortage that creates the attractive bonds between atoms. It is this attraction between incomplete charges that we call the pseudocoulombic force. It has got the appearance of the coulombic force but it remains quite different in essence and explanation.

We should indeed remember that the electron is equally attracted by the pro-ton of the sep to which it belongs and so its charge is torn between the internal proton and the external atoms. Since it is obvious that internal and external forces must be equal, it gives us the possibility to calculate the charge of the external electron of the iron atom for example.

Biding force of atoms in iron

By experience we know that the tensile strength of iron (modulus of elastici-ty) is 540 MPa. The cross-section of an iron atom is a^2 where a is its radius = $2.86.10^{-10}$ m and so the section is $2.572.10^{-19}$ m^2. Each atom must therefore exert a tensile force of:

$540.10^6 \times 2.572.10^{-19} = 1.388.10^{-10}$ N

Let's express this strength with this empirical formula:

$$F_{trac} = \frac{e^2}{\varepsilon_0 2r^2} = 3.53.10^8\ N \qquad (1)$$

In which:
- e is the standard electric charge (1,6.10-19 coulomb),
- a, the coefficient of fine structure
- e_0, the Dielectric constant
- r, the radius of the atom.

We obtain $3.53.10^{-8}$ N. This strength is clearly stronger as that deduced from experience. The coefficient 2 in the denominator is justified by the fact that the atoms cling two to two and that each exerts the same force.

The difference is explained by the fact that, in atoms, *electrons do not have the same active charge as a free electron*. This is noted but not understood by physicists. They express this difference by the introduction of the Fine Structure Constant α.

We know that this constant is, even today, somewhat mysterious and that its calculation is done empirically so as to correspond to the results obtained by Rydberg.

$$\alpha = \frac{e^2}{2\varepsilon_0 hc} \sim \frac{1}{137} \qquad (2)$$

But currently it considered as a constant. It seems that, on the contrary, we must admit that it is a variable coefficient depending on the degree of involvement of the electron in a bond with the proton. Thus, a free electron would have an effective charge equal to the standard charge while a bound electron would have an effective charge expressed by α. And we have to calculate the values of this coefficient as a function of the rank of the orbit on which it is located in the atom.

Calculation of the "alpha" coefficient”

First of all, note that iron atoms have a radius of 2.86.10^{-10} m, or (2.86.10^{-10} / 5.29.10^{-11}) = 5.4 times the Bohr radius. Let us remember that the Bohr orbit is considered the fundamental orbit of the atom and that it is therefore for this orbit that the current *Fine Structure Constant* is relevant. Thus, we can assign to the Bohr radius the value of the Fine Structure Constant as calculated ac-cording to formula (2) and we still have to find a method of calculating this coefficient for the other orbits.

My research to reconcile the results of Rydberg and Bohr with the need mentioned above led me to propose the calculation method below.

$$\alpha_1 = 1/\sqrt{1^2}$$
$$\alpha_2 = 1/\sqrt{1^2+2^2}$$
$$\alpha_3 = 1/\sqrt{1^2+2^2+3^2} \qquad (3)$$
$$\alpha_{38} = 1/\sqrt{1^2+2^2+3^2+\cdots 38^2} \approx \frac{1}{137}$$

Figure 1: Values of □ in regard to the rank of orbits.

1	1,00000	17	0,02367	33	0,00893	49	0,00497
2	0,44721	18	0,02178	34	0,00855	50	0,00483
3	0,26726	19	0,02012	35	0,00819	51	0,00469
4	0,18257	20	0,01867	36	0,00786	52	0,00455
5	0,13484	21	0,01738	37	0,00754	53	0,00443
6	0,10483	22	0,01623	38	0,00725	54	0,00431
7	0,08452	23	0,01521	39	0,00698	55	0,00419
8	0,07001	24	0,01429	40	0,00672	56	0,00408
9	0,05923	25	0,01345	41	0,00648	57	0,00397
10	0,05096	26	0,01270	42	0,00625	58	0,00387
11	0,04446	27	0,01201	43	0,00604	59	0,00377
12	0,03922	28	0,01139	44	0,00584	60	0,00368
13	0,03494	29	0,01081	45	0,00564	61	0,00359
14	0,03139	30	0,01028	46	0,00546	62	0,00351
15	0,02840	31	0,00980	47	0,00529	63	0,00342
16	0,02585	32	0,00935	48	0,00513	64	0,00334

and thus, the rank of Bohr's orbit in the atomic system that follows from this proposal would be 38. It would, however, be beyond the scope of this note to demonstrate that the fundamental Bohr orbit is not a particular one.

We can now calculate the charge of the electrons responsible for the strength of iron in equation (1) by introducing the coefficient □ which corresponds to the rank (38-5.4) = 33 of their orbits.

$$e_{33} = 1.6.10^{-19} x\ 0.008934 = 1.429.10^{-21} coulomb$$

And with this effective charge the force exerted by each iron atom will be:

$$F_{trac} = \frac{e^2\alpha_{33}}{\varepsilon_0 2r^2} = 3.158.10^{-10}\ N$$

The force thus calculated is 2.27 times greater than that obtained experimen-tally but this is probably due to the fact that we assume an ideally structured crystal iron when in reality metals always have structural discontinuities and are weaker than theoretical calculation. But, a part of this difference may also be due to the method of calculating the interaction distance between the atoms. It therefore seems that the results obtained here justify the hypothesis that the effective charge of the outer electrons of atoms is variable.

Implication of this result for the whole of Physics

As soon as we admit that the electric charge of the outer atoms of a material structure varies, we can explain all the laws of Thermodynamics as well as the interactions of matter with electromagnetic radiation.

Let us first remember that all bodies emit radiation according to their temperature. It follows that all bodies also perceive the radiation emanating from their environment. When the amount of radiation emitted is equal to the amount perceived, the body is in thermal equilibrium with the surrounding environment. Moreover, we know that the outer surface of bodies is constitut-ed by the electrons of their atoms. It is therefore the electrons of these atoms that emit and perceive part of their electric charge. This implies that the wavefronts of electromagnetic radiation consist of the same substance as that of electrons.

If now the electrons of the atoms of a solid structure manage to capture from the outside a sufficient amount of charge to fill their deficit, they will no longer need to cling to each other. If electric charges from the outside are abundantly available and atoms continue to absorb them, they will have satu-rated external charges and will begin to repel each other according to Coulomb's law.

We are witnessing here a qualitative sudden transformation of the state of matter by a continuous quantitative progression of the electron charges. In a first stage the solid captures electric charges coming from an outside radiation. Its temperature and volume increase because the absorbed charges add up to those of the atom's electrons and modify the conditions of interaction between electron and proton. We remember that the atom absorbs and re-emits part of the charge at the rhythm of its pulsations. This rhythm is that of infrared radiation as we can measure it. The inner atoms can also benefit from this input because the secondary emissions take place in all directions of space. As the absorbed charge quantity increases and gets distributed over the whole solid volume, the bonds between the atoms become less tight. Then comes the stage where the bonds are neither attractive nor repulsive, this is the liquid state. Every new input will further raise the temperature till the outer charges generate repulsive interactions (when charges of all atoms are equal to the threshold charge). Then starts the gaseous state.

Note also that we can explain why a very cold metal sticks to the hands and why it becomes brittle like glass under the effect of a shock. The outer electrons of this metal cling very strongly but with a very low force since it de-pends on the amount of charge.

Conclusions

The process we have just described is the one generating the binding force between atoms to form molecules. It accounts clearly for all the knowledge we have today on matter in its different states. We find here the explanation for the thermodynamic changes in volume and temperature, for the viscosity, for the specific heat capacity, for the mechanical characteristics of materials and the thermal conductivity.

We have made no particular hypothesis. We got to this result because at the beginning of this work we have postulated that the electron is not a dimensionless corpuscle and that the electromagnetic radiation is of the same nature as that of the charge of the electrons.

Note that the binding force that we have just described is the force called electromagnetic in actual physics. We will not insist on the intellectual con-structions that the explanation of this force requires today. We shall just quote a reputed physicist: " The cohesion of matter is perfectly understood: the atoms are made of nuclei and electrons. Certainly, the electrons (and the nuclei) of two atoms repulse each other, but the electrons of the one attracts the nu-cleus of the other and vice versa. The balance of this subtle set of attractive and repulsive forces is attractive. In quantum mechanics the coulombic forces explain perfectly the cohesion of atoms in molecules as well as in macroscopic solids [3].

References

1. Electrons can repulse if they have the same superficial density, which is not the case when their radii are different.
2. Yves ROCARD, Thermodynamique,(1952) Masson, 336
3. Jean-Marc LEVY-LEBLOND,(1986) Private Correspondance, sept.