A New Way To Harness Energy

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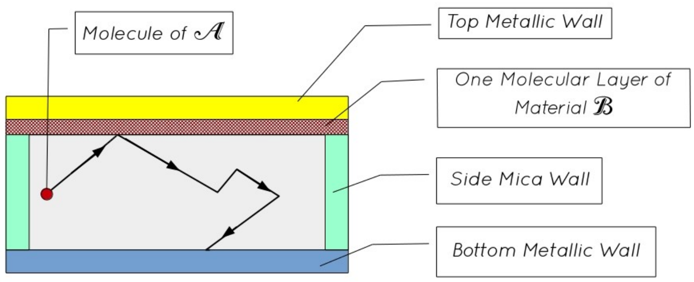
Abstract

Here we are proposing a method to harness energy in a green way. The method uses the fact, if two molecule with different electron affinity mechanically forced to interact with each other, electrostatic energy can be generated. The method has similarity with Photo-Voltaic Cell and Van de Graaff Generator, but it is more versatile and efficient.

1 Theory

Let, $\mathcal{A}$ and $\mathcal{B}$ have different electron affinity and $\mathcal{A}$ is lighter than $\mathcal{B}$. Fine grain of $\mathcal{A}$ is mixed with an appropriate host gas and sealed in a cylindrical container. When this mixture is in thermal equilibrium with surrounding air, grain of $\mathcal{A}$ will perform *perpetual random motion* and will hit against the wall. Height of the cylinder is less than one mean free path of $\mathcal{A}$. So that most likely consequent collision will be at top and bottom wall. Side wall of the cylinder is made of Mica so that top and bottom wall of the cylinder are insulated from each other. Since Mica is good conductor of heat it will also allow good thermal contact. Top and bottom wall of the cylinder are made of conducting material. Top wall is internally coated with *one molecular layer* of $\mathcal{B}$. Hence if static electricity is induced on this layer of $\mathcal{B}$ it will pass through the metallic support.



Design

When fine grain of $\mathcal{A}$ will hit top wall, $\mathcal{A}$ and $\mathcal{B}$ molecule will come close together. Due to different electron affinity of $\mathcal{A}$ and $\mathcal{B}$, a reorganization of charge will take place with certain probability a. In this way top and bottom wall will gain different electric potential. Recoil of $\mathcal{A}$ will separate reorganized charge from each other, as running silk-belt does in Van de Graaff Generator, and it will hit bottom wall where it will be neutralized.

2 Criticism

Before going further with this method let face few relevant questions.

Isn't it against laws of thermodynamics? This method is like working principle of Photo-voltaic Cell. In Photo-voltaic Cell photon knocks off electron. In this case fine grain of $\mathcal{A}$ carries charge out of $\mathcal{B}$.

What kind of energy is converted? Primarily, kinetic energy of grain of $\mathcal{A}$ is responsible for the reorganization and separation of charge. Since grain of $\mathcal{A}$ is influenced by host gas thermal energy of the mixture is converted into electric energy.

Will reorganization of charge take place due to collision? At room temperature *r.m.s* speed of a gas molecule of 200 molecular weight is roughly 6 m/s or 43 km/hr. The speed of manual rubbing is comparable with it. Still we have introduced a probability factor a to take account of quantum and other effects. We have assumed on the bottom wall no such charge reorganization will take place. Otherwise coat it with material of proper electron affinity like top wall.

Will not grain of $\mathcal{A}$ sediment on layer of $\mathcal{B}$ over time? Naturally recoil of molecule $\mathcal{A}$ and random influence of host gas will prevent sedimentation. Although to prevent further this to happen we have chosen height of the cylinder less than mean free path of random motion of $\mathcal{A}$. Hence during very next collision on the bottom metallic wall, molecule $\mathcal{A}$ will be neutralized which in turn will neutralize top wall through external circuit connecting top and bottom wall. Surely, an appropriate choice of concentration of $\mathcal{A}$, density of host gas, grain size and material $\mathcal{A}$ is needed for the continuous operation.

Will not grain of $\mathcal{A}$ stick with each other over time? This is why we have chosen lighter material for the grain so that it remains in its phase.

Why one molecular layer coating is needed? The method generates static electricity, but we need current electricity. Material $\mathcal{B}$ is generally insulator. Notion of conductivity is only applicable to bulk material. A single molecular layer of material can always be electrically communicated.

Is one molecular layer coating possible? With the advent of Nano-technology this can be achieved with some effort.

3 Rough Estimation of Efficiency

To estimate power/unit area let,

Number density of mixture is $\mathcal{N}/m^3$
Fraction of $\mathcal{A}$ is n_A
Temperature is T K
Molecular Weight of $\mathcal{A}$ is M_A
Intrinsic Probability of Ionization is a

Energy for Each Ionization is E_I
R.M.S speed of Molecule $\mathcal{A}$ is v_{rms}

Rate of Collision/Unit Area: Let us consider an inclined cylinder of base area δA, height h and angle between its axis and the wall is θ. Then

$$\frac{h}{\sin\theta} = v_{rms}\delta t$$

Volume of the cylinder is

$$h\delta A = v_{rms}\sin\theta \; \delta A\delta t$$

Number of molecule $\mathcal{A}$ in this cylinder is

$$v_{rms}n_A\mathcal{N}\sin\theta \; \delta A\delta t$$

These all molecule will hit the wall in time δt. To calculate total number of collision for all such cylinder we have to integrate this expression for θ and azimuthal angle ϕ. After integration we have the following expression

$$4\pi v_{rms}n_A\mathcal{N}\delta A\delta t$$

So, rate of collision/unit area is $4\pi v_{rms}n_A\mathcal{N}$.

Power/Unit Area: Due to distribution of velocity assume half of the colliding grain have enough energy. Hence, dividing the above expression by 2 and multiplying by energy for each ionization E_I and intrinsic probability of ionization a we have power/unit area as follows

$$2\pi a v_{rms}n_A\mathcal{N}E_I$$

Expressing v_{rms} in terms of temperature T we have

$$2\pi a n_A\mathcal{N}E_I\sqrt{\frac{3RT}{M_A}}$$

Using the value $a = 0.01\%$, $n_A = 10\%$, $\mathcal{N} = 10^{24}/m^3$, $E_I = 10^{-19}$J ($<$ 1eV), $T = 300$K and $M_A = 200$ we obtain 38.412 watt$/m^2$.

4 Conclusion

The estimated power is really impressive in comparison to other conventional methods. Apart from it, this method has other advantages. Like it can work day and night almost in any whether condition, it can be placed any where in any orientation, it can be stacked to build energy grid. On the down side the surface area has to be large enough for required current. This limitation can be overcome with proper geometrical shape like it can be folded in a cylindrical manner. The most difficult technical part is the coating, achieving fine grain and appropriate choice of $\mathcal{A}$ and $\mathcal{B}$.