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The ultimate energy; Regenerative Ionic Cells (RIC)

Right in front of our eyes everything we see is already 'stored energy,' 100% clean and with endless supply, inherited from the Big bang.

Can we extract this energy at a reasonable cost, without radioactivity, explosions, or plasma temperatures? The answer is yes; at temperatures below 100 C and at speeds that can be controlled. The energy produced will equal to the speed of light squared times the loss of used-up mass (Einstein's special relativity formula $E=MC^2$).

Can a car like Tesla-X travel a million miles by using 0.01gram of hydrogen? Can a rocket to the moon weigh 85% less? Can a car speed into orbit? The answer to all these questions is the same "yes."

So, what are we waiting for to prove this and start a new age in human civilization? We are waiting for the generation of decision makers who grew up with Lavoisier's law of conservation of mass to be replaced by the generation that were educated by the concepts of Einstein.

Additional submitted attachment is included below.

No. 1 GOAL IS TO STOP GLOBAL WARMING

Global warming since the Industrial revolution is mainly a consequence of the humans burning fossil fuels and the slow human response in developing totally clean, readily available, sustainable, low-cost clean energy form(s) as alternatives to the fossil fuels.

There is an endless and totally clean energy source that has not been considered. It is by far the cleanest & the most sustainable energy form, and it surrounds us in the form of 'energy/mass' locked in elements since their creation after the Big Bang.

The latest understanding of the subatomic physics and the thermodynamics' First Law for the closed Systems allow creation of totally clean electrical energy from protons & electrons under the right conditions in the expense of the loss of minute amounts of the Hydrogen's proton/electron mass.

This energy promises to be the only ultimate clean energy that could stop global warming within the short period that remains before the warming issue becomes impossible to stop due to several domino effects. It could be the civilization savior we are looking for.

The U N Panel on Climate Change (IPCC) in its June 2021 draft report¹ warns “**The worst is yet to come.**” “Unless drastic & immediate action is taken to limit global temperatures from rising further, life on earth is poised for a catastrophic reckoning.”

SOLUTION OFFERED BY THIS PATENT

Basically, involves the use of the mass-energy of the same Hydrogen in repeated cycles of ionization and reformation to generate electricity using three spontaneous reactions that are forced to take place in a closed chamber. Electricity can be continuously generated until any one of the three reactions is no longer energetically possible.

Regenerative Ionic Cells, “RIC”

- **RIC** relies on the largest and most readily available energy source: matter, which is made of protons, neutrons, and electrons. While the invention will work with many other low ionization temperature elements, we will utilize Hydrogen gas as the energy source.
- There is no radioactivity, no Greenhouse Gas (GHG) emissions, and no waste products, no toxic waste spills due to fuel extraction, transport, and distribution
- No fuel distribution or charging station grids are needed.
- **RIC** does not depend on the Sun, the wind, waves, seasons, location, or batteries.

- **RIC** is mass producible and readily adoptable for any application: mobile, stationary, high, or low-power requirements, and miniaturization.
- **RIC's** estimated initial capital cost/kW will be the lowest among all available energy forms.
- Its fuel cost will be nearly zero; annual worldwide fuel savings will be approximately \$5-6 trillion USD.
- **RIC** will therefore be the only 100% clean energy form that can be implemented, cheaply, massively within the short window of opportunity left for the mankind to avoid a historic disaster.

INNOVATIONS

The Regenerative Ionic Cells (RIC) concept, in many ways is like Hydrogen Fuel Cells (HFC), except that it uses no oxygen or a membrane, and it needs no hydrogen & oxygen supply lines.

But it will have a sealed reaction chamber filled with a few grams of Hydrogen, which may be the sole “fuel” needed for a lifetime of a vehicle or a residential home.

When the ionization temperature is reached, hydrogen ionizes into electrons and protons. Electrons are attracted to the load circuit due to the electron gradient (voltage) created. And protons are immediately captured by the carrier fluid (water) at the anode, and travel to cathode as hydronium ions. At the cathode, protons and electrons returning from the load circuit, recombine to create the neutral Hydrogen atom. This cycle repeats since all conditions for ionization of hydrogen in the chamber still exists.

Repeated hydrogen ionization at the anode, and hydrogen reformation at the cathode cycles create a steady supply of electricity for work outside the system.

RIC process allows extraction of an infinitesimally minute portion of the Hydrogen's mass energy to generate electricity.

Three 'spontaneous' chemical reactions are involved in repeated cycles of ionization and reformation of Hydrogen atom in a thermodynamically closed system. All involve Hydrogen atom and its electron and proton.

In this approach reactions that allow electricity generation in the expense of the hydrogen's mass energy have no choice but to take place since the three reactions that create electricity are all spontaneous and occur in a closed chamber, and the closed chamber has all the reactants (Hydrogen-protons-electrons) needed for the three reactions to continuously proceed.

Thus, since the energy generated comes from the mass-energy of the hydrogen, it is not “free” energy. And it is not perpetual since the energy extraction from the hydrogen

will no longer take place when the remaining mass-energy of hydrogen becomes too low for the electron-proton electromagnetic attraction to reform the hydrogen atom.

The **RIC starts with ionization of the Hydrogen at the anode** (The first reaction below). Electrons freed by ionization are attracted to a conductor connected to a load outside the closed chamber. **Electrons travelling in a conductor create electromagnetic field, which creates an electric current that performs work outside the chamber such as, lighting, heating, running an electric motor, and arrive at the cathode to regenerate Hydrogen.**

Since this system loses energy due to the work done outside the System, the energy utilized must come from the internal energy of the “closed” system in accordance with the Einstein’s energy/mass equation: $(E=MC^2)^{2,3}$ and the 1st law of thermodynamics⁴. Einstein’s special theory of relativity, as expressed by the equation above, states that mass is energy, and energy and mass are interchangeable using square of the speed of light as the proportionality constant as shown in the formula.

RIC reactions are all spontaneous at the ionization temperature of the Hydrogen.

At the anode: 1st Reaction: $H_2 \rightarrow 2H^+ + 2e^-$ (ionization is spontaneous at 350°K)⁵.

2nd Reaction: $2H^+ + 2H_2O \rightarrow 2H_3O^+$ (Ref. 6) where protons are spontaneously and naturally attracted to the large negative charge field surrounding Oxygen atoms in water.

At the cathode: 3rd Reaction: $2H_3O^+ + 2e^- \rightarrow 2H_2O + H_2$

1st Reaction absorbs energy for the ionization of hydrogen, therefore, increases the System’s internal mass (energy).

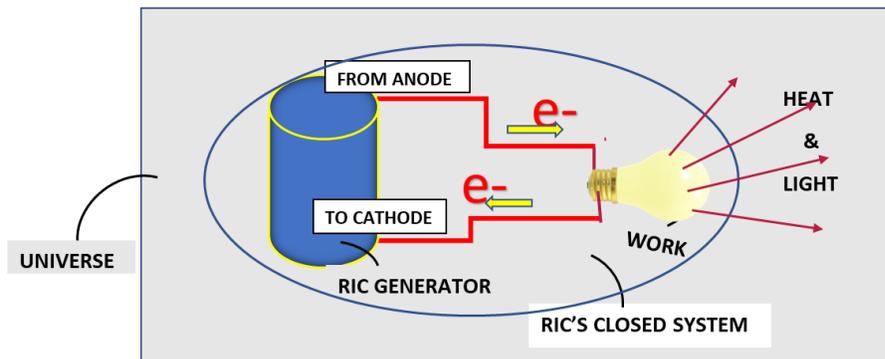
Electrons freed by ionization move in the conductor towards the cathode and to perform work outside the chamber releasing energy and involving in de-excitation of the system, which decreases mass (internal energy of the system). This decrease in mass is the most decrease that occur in the present system, as the other mass increases or decreases involve minor changes in energy.

In the 2nd Reaction freshly freed low velocity positively charged protons are attracted to electron fields of the Oxygen atoms in water molecules with which they come into contact, causing the proton and water molecule to temporarily combine. Such molecules are then said to be "protonated", and are called hydronium ions, H_3O^+ . As the protons hop from one water molecule to the next, bonds are formed and broken each time between protons and water molecules. The overall energy (mass) change therefore is too small to be noticed.

3rd Reaction also occurs spontaneously and is de-excitation of the reactants, which decreases mass.

Several innovations are involved, relating to the **RIC process** kinetics and architecture. **Creating a sealed reaction chamber results in a closed system.** No “matter” (like electrons and protons) is exchanged between the system and the surroundings. Work (energy release outside the system) is allowed since only the electrons travel outside the sealed chamber on their way to the cathode, there is no loss of electrons (matter). Thus, the system thermodynamically **obeys the First Law** for closed systems.

The closed system’s **internal energy is the Hydrogen’s mass/energy** inside the sealed reaction chamber. **Repeated ionization-reformation cycles produce a stream of electrons at the anode and use the internal energy of the Hydrogen to perform work until the protons & electrons can no longer recombine.** Resulting in “fuel” cost being nearly zero.



Here the operating law is the First Law,⁴ stated mathematically as:
Change in internal energy, $\Delta U = Q - W$,
where Q is net energy transferred into the System
W is the work done by the System.

If $Q > W$, the difference is stored as internal energy.

If $Q < W$, internal energy supplies the difference, reducing the mass of the internal energy. **This is what takes place in RIC's sealed reaction chamber.**

Relevant Latest Subatomic Physics:

- According to Einstein's proven formula $E=Mc^2$, any reaction that involves a change in energy must be accompanied by a change in mass. ⁽²⁾ ⁽³⁾
- Excitation of a system to different states always absorbs energy and increases mass, and de-excitation releases energy and decreases mass. ⁽³⁾
- Mass increases and decreases involve the whole system. ⁽³⁾
- Energy lost from a closed system, is extracted from the internal energy of the system. This understanding replaces Antoine Lavoisier's ⁽⁸⁾ "Law of conservation

of mass” which until a decade or so ago was held as the first law of thermodynamics.

RIC does not need Oxygen: this eliminates explosions, simplifies architecture & Reduces cost when compared to a Hydrogen Fuel Cell (HFC).

Another Innovation involves the use of a force like centrifugal force in transporting protons from the anode to the cathode in a carrier fluid like water, as Hydronium ions⁶ (H³O⁺.)

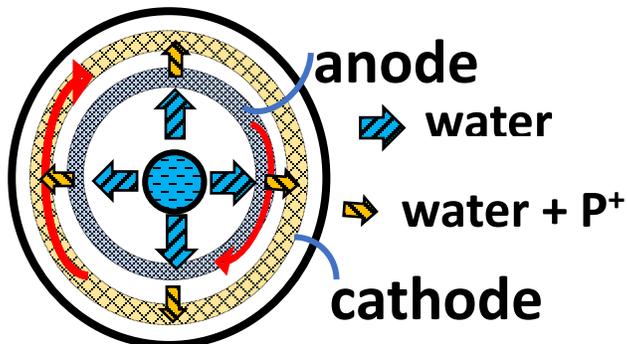
RIC design allows application of force to accelerate proton travel from anode to the cathode, resulting in proton travel to cathode at speeds much higher than the speed of just diffusion, as is the case in conventional Hydrogen fuel cells. Higher proton travel speeds lead to shorter Hydrogen reformation cycles, which lead to the production of power outputs sufficient even for jet engines.

In conventional Hydrogen Fuel Cells (HFC) Proton diffusion through a membrane relied on is too slow; and **is the rate limiting step**. In contrast, entrance of ionized electrons into the conductor at the anode results in “other” electrons at the other end of the conductor to enter the cathode at speeds near 1/100th of the speed of light. In other words, proton transport is too slow with respect to the electron transport to the cathode.

Therefore, mechanical acceleration of the protons as hydronium ions in water to the cathode can lead to large increases in power outputs and provides a means for instantaneous control of the power output, and making **RIC** readily suitable for cars, trucks, airplanes, trains, ships, and space applications, as well as stationary applications.

Table below compares power outputs of a centrifugal **RIC** with those of a standard HFC with anode reaction surface area being equal to that of the **RIC** anode surface area, and the HFC requiring a calculated 0.24 second diffusion⁷ time (which typical) across its 0.1 mm thick Nafion membrane.

Where, RPM = Centrifugal Rounds Per Second
 SPR = Seconds Per Round
RIC Power output = (0.24s/SPR) x Output of a typical HFC.
 Centrifugal **RIC** cross-section is shown at left.



<u>RPM</u>	<u>SPR</u>	<u>OUTPUT</u>
6,000	0.01	24XHFC
60,000	0.001	240XHFC
200,000	0.0003	800XHFC
600,000	0.0001	2,400XHFC

RIC's IMPACT will be a game changer, ushering in a totally clean, endless ultimate energy source, which will preserve earth's beauty, reduce poverty, and offer hope for the humanity. Worldwide, it will roughly reduce annual energy cost from \$7 trillion/yr. (2020) down to \$1-1.5 trillion. Plus, **RIC** will not need fuel or charging station grids.

In comparing RIC to other Renewable Energy Forms⁹ in terms of Power Capacity, Capital Costs, GHG Emission and Sustainability, **RIC** comes out ahead of all in all categories. **RIC's** Estimated capital cost in \$/kW at about \$100 is the lowest. Next lower being solar-PV at \$1060/kW, which is dependent on the weather and location. Conventional Fuel Cells' capital cost is about \$7200/kW.

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