

# The Novel Hyper-Combustion for the Complete Combustion of Fossil Fuels

Ruggero Maria Santilli

**Abstract**—The current combustion of fossil fuels is essentially the same as it was at the dawn of our civilization some fifty thousand years ago. In fact, we strike a spark and ignite the fuel, with increasingly alarming climactic changes due to the lack of complete combustion. In preceding works, the author achieved the complete combustion of the synthesized fuel known as *magnegas*. In this paper, we propose, apparently for the first time, new principles of combustion under the suggested name of *HyperCombustion* (patent pending) based on the recently achieved fusion of Carbon and Oxygen into Silicon without the release of harmful radiation, with ensuing significant increase of the energy output, the achievement of complete combustion, and the reduction of the green house gas  $\text{CO}_2$  for a given energy output.

**Index Terms**—Molecular combustion, magnecular combustion, hypercombustion.

## I. INTRODUCTION

Our increasingly alarming environmental problems (see, e.g., Fig. 1) are mostly due to the current combustion [1]-[6] of commercially available fossil fuels, such as gasoline, diesel or coal, which is essentially the same as it was at the dawn of our civilization some fifty thousand years ago. In fact, we essentially strike a spark and ignite the fuel, resulting in the release of excessive contaminants.

In this paper, we outline the studies on combustion by the author initiated in the late 1970's while he was at Harvard University under support from the Department of Energy [7]-[72] and propose, apparently for the first time, basically new principles of combustion here submitted under the name of *HyperCombustion*<sup>TM</sup> (patent pending) which aims at the achievement (in due time and following due investments) of a *complete combustion* of fossil fuels, hereon referred to as a combustion without combustible contaminants in the exhaust.

For this task, we identify in Section II the features of conventional combustion that are responsible for the indicated environmental problems; we then outline in Section 3 the novel magnecular combustion that has already achieved the indicated complete combustion for the gaseous fuel magnegas; we introduce in Section IV the principles and available experimental evidence of *HyperCombustion* offering realistic possibilities of extending to fossil fuels the complete combustion already achieved by magnegas; and we close the paper with expected environmental implications of

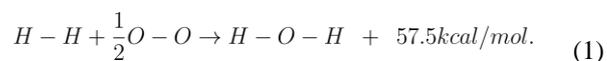
*HyperCombustion* and open problems.



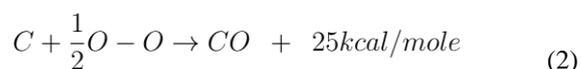
Fig. 1. A view of the atmospheric pollution in Beijing, China, on a sunny day.

## II. MOLECULAR COMBUSTION

The terms *molecular combustion* are hereon referred to as the current combustion of fuels with conventional molecular structure (Fig. 2), thus being composed by atoms such as carbon C, hydrogen H and other elements bonded together by the conventional valence bond (alternatively called covalence bond) which is hereon indicated with the symbol “-.” Well known examples (see Refs. [1]-[5] are given by the combustion of hydrogen and oxygen]



that of carbon and oxygen symbol



and others [1]-[6].

Note that, according to our definition, combustion (1) is “complete” (because  $\text{H}_2\text{O}$  is not combustible), while combustion (2) is “incomplete” (because  $\text{CO}$  is combustible). In this study, we also assume, for simplicity, that we have the perfect stoichiometric ratio between fuel and oxygen to prevent the incompleteness of otherwise complete reactions, such as (1).

In the author's view and experience, despite advances that are clearly historical [6], the achievement of a full combustion of commercially available fossil fuels requires the identification and resolution of the following open

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problems of quantum chemistry with particular reference to its treatment of combustion (see, e.g., Section II of Ref. [16]):

2.1. The 20th century notion of “valence bond” is merely conceptual due to the lack of a quantitative identification of the bonding force because *two identical valence electrons must repel, and certainly not attract each other according to quantum mechanics and chemistry since they have the same charge*. The ensuing lack of a quantitative representation of the “molecules.” then clearly prevents basic advances in the combustion of fossil fuels.

2.2. As it is well known, all combustions are irreversible over time, while quantum mechanics and chemistry are strictly reversible over time from their axioms and dynamical equations. Consequently, quantum mechanics and chemistry are only approximately valid for a quantitative treatment of combustion. The lack of axiomatically and dynamically correct formulations for irreversible chemical reactions is an evident additional limitation for the improvement of combustion since it does not allow reliable theoretical predictions.

2.3. Due to their local-differential mathematical structure, quantum mechanics and chemistry can only represent energy releasing chemical reactions as occurring in between point-like molecules solely under action-at-a-distance potential interactions. In fact, said theories cannot represent non-linear, non-local and non-potential interactions expected in all energy releasing processes, which broader interactions were assumed by Lagrange and Hamilton to be necessary for the representation of nature and were represented via external terms in their celebrated equations that are absent in 20th century sciences.

Additionally, despite a century of studies, we remain with ambiguities in the presentation and treatment of the energy released by basic combustions, such as (1) [2]-[4] whose resolution, as we shall see, is important for the achievement of the complete combustion of fossil fuels. Consider, as an example, the widespread statement that combustion (1) produces 57.5 kcal/mole. However, as evident from the structure of water  $H - O - H$ , a necessary condition for combustion (1) is that the hydrogen and oxygen “molecules” are separated into “atoms” requiring 104.2 kcal/mole and  $119.1/2 = 59.5$  kcal/mole. Consequently, in order not to violate the conservation of energy, the energy output of combustion (1) should be

$$104.2_{Hsep} + 59.5_{Osep} + 57.5 = 163.7_{mp-sep} + 57.5 = 221.2Kcal/mole \quad (3)$$

The author initiated his studies of the complete combustion of fossil fuels with the first and only known quantitative identification of *attractive force in valence coupling* thanks to the prior construction of the novel *isomathematics* [7]-[9] for the representation of non-linear, non-local and non-Hamiltonian interactions in total mutual penetrations of wavepackets, with ensuing *isomechanics* [10], [11] and *isochemistry* [12]. The resulting attractive valence force, known as *Santilli isovalence bond* [p.12], resulted to be so strong to overcome the repulsive Coulomb force as well as permit the first known *exact* representation of the binding energies and other data of the hydrogen [13] and water [14] molecule.



Fig. 2. An illustration of the fact that the current combustion of fossil fuels is the same as it was at the dawn of civilization.

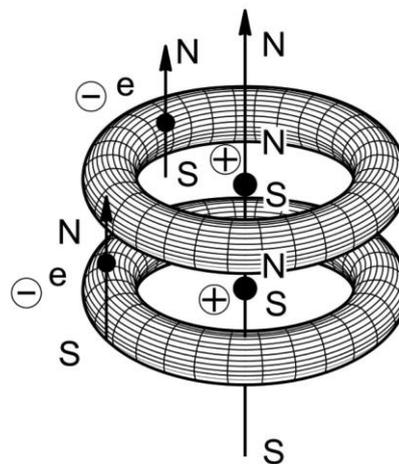


Fig. 3. A view of the basic magneccule between Carbon and Oxygen which is at the basis of the new combustion.

Despite the achievement of an attractive valence force, isoformulations remained reversible over time in both their axioms and dynamical equations because it is necessary to represent the reversibility over time of isolated molecules. In order to achieve a resolution of irreversible chemical reactions, the author had no other choice than to build broader formulations for the vresolution of insufficiencies 2.1, 2.2 and 2.3, including the covering *genomathematics* [7]-[9] embedding irreversibility in the most basic operations, such as ordered products and units, with ensuing *genomechanics* [10], [11] and *genochemistry* [12]. The axiomatic and dynamical consistency of the broader genoformulations was proved in Refs. [15], [16].

Unfortunately, we have no possibility of even outlining these above isotopic and genotopic formulations to prevent a prohibitive length. Nevertheless, their knowledge is essential for a true understanding of the HyperCombustion presented in Section IV. A recent general review by the author is provided in Sections II and III of Ref. [16], independent studies are available from monographs [17]-[20], while a general independent review is available in Ref. [21].

### III. MAGNECCULAR COMBUSTION

According to the studies outlined in the preceding sections, the inability of commercially available fossil fuels to achieve a complete combustion is due to: the strength of valence bonds that cannot be entirely broken under the released energies; the combustion temperature which is insufficient to

infinite combustible contaminants in the exhaust; and other factors.



Fig. 4. view of the gasifiers built by the author when Chief Scientist of Magnegas Corporation converting liquids into the clean burning magnegas fuel.

Following, and only following, the identification of the actual attractive force in valence bonds a related quantitative representation of molecular structures [7]-[12], the author initiated in the 1990's the search of means to *weaken* valence bonds because in the evident hope of improving the currently available combustions. Following a number of unpublished trials and errors, the author had no other choice than that of working out a *new chemical species* with a bond *weaker* than the valence bond.

Following a decade of research, the author reported in Ref. [22] of 1998 (see also the comprehensive treatment in monograph [21] of 2001) mathematical, theoretical and experimental evidence suggesting the existence of a new chemical species structurally different than that of molecule, today known as *Santilli magnecules* [21] which consists of atoms H, C, O, etc., dimers C-H, H-O, etc, and ordinary molecules H-H, C-O, etc. bonded together by opposing polarities of toroid configurations of atomic electrons achieved under suitably strong magnetic fields [23] (see Figure 3 for a view of the "elementary magnecule").

ORS REPORT NO. 198809-001	Mass 31 4,701 4,217	Mass 63 2,118 2,383
DATE TESTED 9/5/2012	Mass 32 14,980 28,590	Mass 64 439 447
QUANTITY TESTED 2	Mass 33 423 524	Mass 65 6,521 6,664
PACKAGE TYPE ORS CYLINDER	Mass 34 155 247	Mass 66 9,564 9,010
MFG. CODE EQ-09-012 + EQ-02-171	Mass 35 0 168	Mass 67 9,081 7,743
FILLED BY C.LYNCH ON 8/30/12	Mass 36 16,074 7,239	Mass 68 4,657 3,606
PO: 1830	Mass 37 74,295 39,715	Mass 69 1,748 2,908
REL. NOS:	Mass 38 98,482 56,569	Mass 70 4,332 6,363
CINO ANATO	Mass 39 404,322 256,466	Mass 71 763 2,293
MAGNEGAS CORPORATION	Mass 40 183,529 94,167	Mass 72 496 1,411
150 RAINVILLE ROAD	Mass 41 374,503 306,605	Mass 73 443 1,100
TARPOON SPRINGS, FL 34689	Mass 42 189,757 141,041	Mass 74 905 1,499
UNITED STATES	Mass 43 36,727 69,614	Mass 75 341 494
SAMPLE ID EQ09012 EQ02171	Mass 44 54,064 369,443	Mass 76 2,330 2,423
Mass 2 177,131 150,391	Mass 45 2,578 8,509	Mass 77 3,975 4,736
Mass 3 93,300 77,390	Mass 46 413 1,766	Mass 78 15,379 17,902
Mass 4 16,354,930 14,397,630	Mass 47 0 382	Mass 79 1,852 2,082
Mass 5 373 242	Mass 48 6,234 1,706	Mass 80 405 361
Mass 6 20,779 16,402	Mass 49 29,437 9,298	Mass 81 356 532
Mass 12 1,208 753	Mass 50 83,295 27,897	Mass 82 436 530
Mass 13 73 70	Mass 51 42,007 22,582	Mass 83 172 470
Mass 14 4,517 3,851	Mass 52 41,456 16,482	Mass 84 856 1,666
Mass 15 641 518	Mass 53 41,418 26,917	Mass 85 260 871
Mass 16 4,393 2,411	Mass 54 45,433 25,407	Mass 86 0 427
Mass 17 9,362 3,121	Mass 55 29,050 33,592	Mass 89 0 195
Mass 18 39,386 12,362	Mass 56 34,884 42,986	Mass 91 867 4,748
Mass 19 5,922 2,123	Mass 57 3,372 8,542	Mass 92 547 2,451
Mass 20 17,998 4,954	Mass 58 3,130 5,526	Mass 93 0 166
Mass 22 178 0	Mass 59 507 1,111	Mass 96 0 144
Mass 24 239 0	Mass 60 436 1,410	Mass 97 0 229
Mass 26 1,943 236	Mass 61 1,006 1,153	Mass 98 0 233
Mass 27 466 320	Mass 62 1,269 1,456	Mass 100 0 279
Mass 28 43,690 28,234		
Mass 29 1,186 881		
Mass 30 1,305 382		

Fig. 5. Reproduction of a certified chemical analysis of magnegas showing the presence of constituents from 2 to hundreds of amu.

From 2007 to 2012, in his capacity of Chief Scientist of the publicly traded company *Magnegas Corporation* (www.magnegas.com), the author constructed reactors (see an example in Fig. 4) converting liquids into a gaseous fuel

known as *magnegas*. Since the gasification process was done via a submerged DC electric arc, it had to have the necessary strength for the toroid polarization of atomic electrons. Said polarizations evidently disappear at the disconnection of the arc. Nevertheless, pairs of polarized and coupled atoms as in Fig. 4 retain their bond at ambient temperature, thus having the stability necessary for industrial applications. In this way, the author identified a number of fuels with a magnecular structure covered by U. S. Patent 9,700,870, B2 [24], including: magnegas (MG) [25]; magnehydrogen (MH) and magneoxygen (MO) [26]; a new gaseous form of water (HHO) [27]; and other magnecular gases [28].

According to the above studies, under condition of polarization MG is composed by a collection of magnecules here referred to as clusters with magnecular bonds of all atoms, hereon denoted "x" that can be symbolically represented with the structure

$$MG = \{H \times H + H - H \times H + H \times H \times H + C - O \times H + \dots\} \quad (4)$$

The above chemical structure has been confirmed by various tests, such as the measurements conducted at *ONEIDA Research Services* of Whitesboro, New York, via methods.

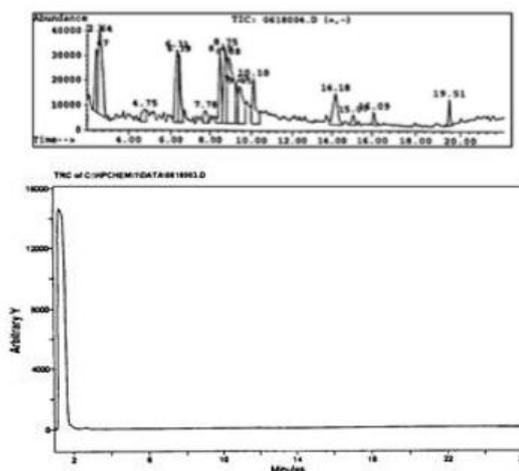


Fig. 6. A view of the first experimental detection of magnecules showing in the top the clusters obtained via a gas chromatographer, mass spectrometer, and in the bottom the lack of detection via an infrared detector thus confirming that the former cannot be molecules.

ORS SOP MEL-1070: Gas Analysis [29] (see Fig. 5 for a summary). These measurements show that MG is composed by clusters from 2 to 200 amu, of course, with different concentrations, thus confirming magnecular structure (4). Note that measurements [29] (Fig. 5) cannot be credibly explained by assuming that MG has a conventional molecular structure.

In addition to the original experimental evidence presented in the author's proposal [12], [22], the existence of magnecules has been confirmed by a number of independent tests [30]-[33] (see also Refs. [34]-[28]). These detections generally turned out to be of difficult understanding by laboratory analysts because they attempt the detection of the new chemical species of magnecules with equipment, such as gas chromatographer mass spectrometers (GC-MS), that has been specifically designed for molecules. This is due to the

fact that magnecules have a bond estimated to be 1/10<sup>th</sup> that of a molecule. As a consequence, ionization means in GC-MS that are so effective for the detection of molecule, generally destroys the magnecular species they have to detect, reduce them to their conventional molecular components, thus showing the apparent lack of new species.

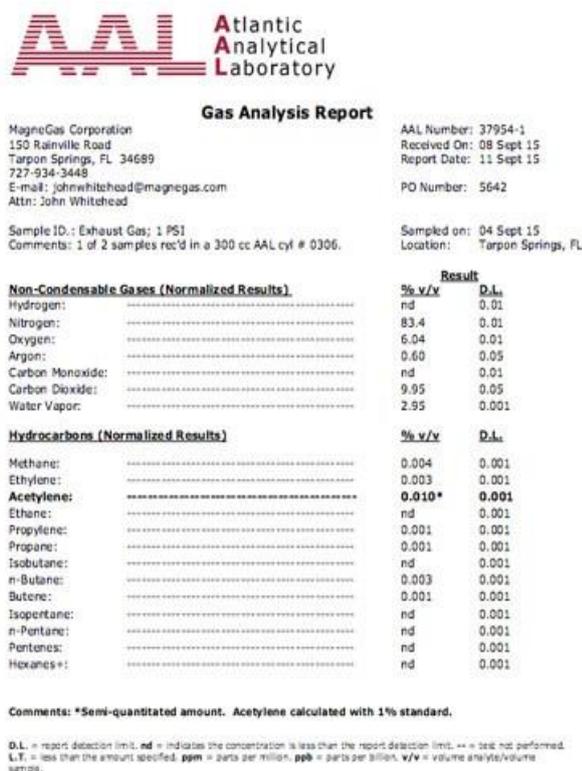


Fig. 7. Chemical analysis of magnegas exhaust by Atlantic Analytic Laboratories showing the absence of carbon monoxide (as ND) and small traces of hydrocarbons.

Since new detectors specifically designed for magnecules are not available at the moment, the only known experimental detection of magnecules remains that of original proposal [22], consisting in an indirect detection via the use of a GC-MS equipped with an infrared detector (GC-MS/IRD). The same sample of gas is first inspected in the GC-MS operated at the minimal possible temperature, ionization energy and other settings, resulting in the identification of the clusters composing the gas. The same sample is then analyzed with the IRD. In the event the IRD confirms the existence of the clusters from the identified by the GC-MS (top view) had a signature under the IRD, thus prohibiting the clusters in the GC-MS to have a molecular structure. Note that CO<sub>2</sub> is detected in the IRD (Bottom left of Fig. 6) but not present in the GC-MS detections (top of Fig. 6), thus establishing that CO<sub>2</sub> is a *constituent* of the magnecular clusters. All subsequent detections [30]-[38] essentially provide a confirmation of said original detections.

GC-MS at their amu, said clusters are conventional molecules. By contrast, in the event the IRD shows no signature at the amu values of the GC-MS clusters, said clusters cannot possibly be molecules due to their lack of resonating frequency. In Fig. 6 we reproduce the original detections of Ref. [22]. As one can see, none of the clusters

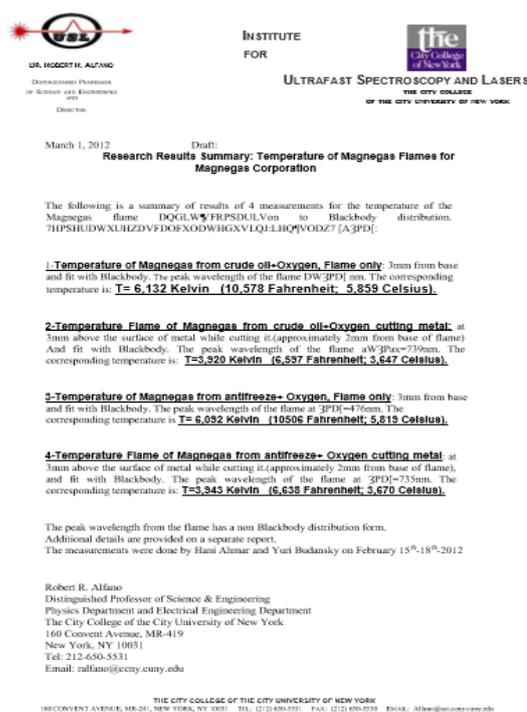


Fig. 8. Spectroscopic analysis of magnegas flame showing a temperature which is about three times that of any other commercially available fue.



Fig. 9. A view of stock cars operated by the author with magnegas without catalytic converter wssing EPA requirements due to the quality of the exhaust shown in Figurehile surpa 7.

The interested reader should be informed that, since the date of Ref. [22] (1998), GCMS and IRD detectors have considerably increased the rapidity of the analyses evidently via the increase of the ionization energy and other advances. While such increases have no effect for magnecules, they

evidently *decrease* the capability of identifying magnecular clusters. In fact, the original detections of magnecules were done via the analytic laboratories of McClellan Air Force Base near Sacramento, CA, via a GC-MS/IRD comprising of a HP GC model 5890, a HP MS model 5972 and a HP IRD model 5965. During the independent tests [30]-[33], the analysts failed to reproduce with modern GC-MS the cluster of MG identified so clearly with the indicated GC-MS, again due to the excessive increase of the ionization energy and other settings in contemporary GC-MS, thus forcing the experimentalists to recondition an old HP GC model 5890, a HP MS model 5972 and a HP IRD model 5965.



Fig. 10. View of a prototype of the new hyperfurnaces.

A first feature of magnegas which is important for environmental aspects is that, as typically the case for all magnetic effects and related Curie Temperature, *magnecular bonds disappear at combustion, thus preventing the loss of separation energies of type (3), with ensuing enhancement of energy output.* In fact, MG cuts metal faster than acetylene with 2,400 BTU/scf, while having a nominal 320 BTU/scf according to standard GC-MS calculations.

The second environmentally important feature of magnegas is that, according to measurements conducted by the Ultra-Fast Spectroscopic Laboratory of the City College of New York [39], [40], *the flame temperature of magnegas is also three times the flame temperature of commercially available fuels, including fossil fuels* (see the summary table of Fig. 7).

The third environmentally important feature is that, under the correct stoichiometric ration and MDS Ignition System, *magnegas does indeed achieve complete combustion.* In fact, according to analyses conducted by Atlantic Analytic Laboratories [41], *the combustion of magnegas in air under correct stoichiometric ratio MG.O)2 and ignition, shows no detectable CO and no appreciable HC* (see the summary table in Fig. 8). Needless to say, under an improper stoichiometric system or insufficient voltage or energy of the ignition, magnegas combustion cannot be complete.

In view of the above features, when he was Chief Scientist of Magnegas Corporation, the author was driving various stock cars produced to run on natural gas (NG) but operated with MG. These cars *surpassed all EPA regulations without catalytic converters.* Note that the above three anomalies establish the magnecular structure of magnegas since the same anomalies admit no quantitative representation via the conventional molecular species.

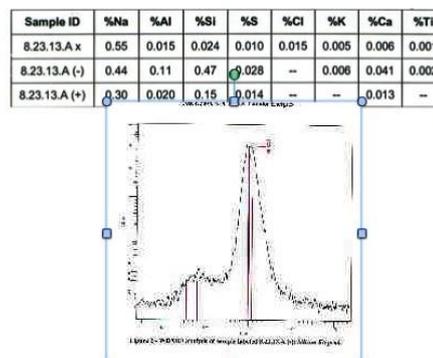


Fig. 11. A view of the certified analysis by Constellation Laboratories s establishing experimental evidence of the central process of the new hypercombustion, I.e., the nuclear fusion of Carbon-12 and Oxygen-16 into Silicon-28.

The above results signaled the achievement by the author of the intended environmental advance. Therefore, the author left Magnegas Corporation for the U. S., publicly traded company Thunder Energies Corporation for the extension of the above results to fossil fuels as described in the next section.

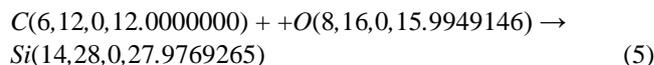
#### IV. HYPERCOMBUSTION

In this section we submit, apparently for the first time, the possible extension of the complete combustion of magnecular fuels of Section III to commercially available fossil fuels (such as gasoline, diesel or coal) under the name of *HyperCombustion*, (patent pending) via the following main new principles:

*PRINCIPLE 4.1: Ignite fossil fuels with a series of rapid DC discharges, each having at least 100 kV and at least 100 J, hereon called HyperSparks.*

*PRINCIPLE 4.2: Convert fossil fuels from their natural molecular structure to a magnecular form,*

*PRINCIPLE 4.3: Enhance the combustion temperature, magnecular conversion and the energy output via the fusion of Carbon-12 and Oxygen-16 into Silicon-28*



$$\Delta E = 0,0179881amu = 16.75591515MeV/c^2 \quad (6)$$

as well as other nuclear fusions, engineered according to the laws of Intermediate Controlled Nuclear Fusions (ICNF) without the emission of harmful radiations and without the release of radioactive waste (see Refs. [42]-[51] for theoretical treatments, Refs. [52]-[60] for independent studies, Refs. [61]-[72] for laboratory report, and Ref. [49] for the synthesis of Silicon, Fig. 10 for an ICNF reactor, Ref. [50] for a DVD on its operation, and Ref. [51] for its sound).

Principle 4.1 is crucial for the achievement of a combustion temperature necessary for a complete combustion as well as for molecular separation and atomic ionization, and from the triggering of ICNF. Principle 4.2, which can be also engineered the highly efficient magnegas reactors, is crucial for the reduction of energy lost in molecular separation, e.g., the lost energy of 163.7 Kcal/mole of Eq. (3). Principle 4.3 is crucial for the

enhancement of all preceding processes, as well as for the increase of the energy output compared to that of conventional combustion of the same fuel.

The equipment implementing the above principles is here submitted under the name of *HyperFurnaces* (see Figure 10 for a prototype and Ref. [50], [51] for short DVD on its operation). In its expected industrial realization, HyperFurnaces are expected to include ceramic realization of the *hadronic reactors* of IUCNF essentially converting the correct mixture of fossil fuel and air into a high temperature exhaust without combustible contaminants via a number of equipment including: computerized stoichiometric ration of fuel and air; exchangers for the desired use of the heat, such as for household radiators or electric generators; a processing station for cooled down exhaust prior to its release in the environment; and overall shield for electromagnetic and other radiations; and other equipment.

Special R&D is recommended for the station treating the exhaust for its safe release to the environment. Said exhaust is expected to contain primarily  $CO_2$ , but also other inert gases as well as solid particulates. The current, increasingly alarming environmental changes suggest the investment of all the necessary funds for the development of such a processing station via molecular separation or the processes so that no harmful gas is released in appreciable quantities.

It is evident that the production of the greenhouse gas  $CO_2$  increases under complete combustion due to the combustion of CO, HC and other contaminants. However, the percentage of  $CO_2$  per energy output is considerably decreased in HyperFurnaces due to the fusion of C-12 and O-16 into Si-28 that produce no  $CO_2$  (see Ref. [49] and Fig. 11).

## V. CONCLUDING REMARKS

In this paper we have submitted, apparently for the first time, a basically new combustion under the suggested name of *HyperCombustion*, essentially consisting in the enhancement of the energy output of fossil fuels combustion via the fusion of C-12 and O-16 into Si-28 without harmful radiation, which fusion has been recently achieved via the *hadronic reactors* (see Fig. 10 for a prototype) of *Intermediate Controlled Nuclear Fusions* (ICNF) (see Refs. [7]-[72] in general, Ref. [49] in particular, and Fig. 11 for a summary of independent measurements).

In case funding is made available for its proper development, HyperCombustion would achieve a complete combustion of fossil fuels with a significant reduction of our current environmental problems. Since ICNF releases no contaminants in the environment, HyperCombustion would additionally achieve a significant reduction of the greenhouse gas  $CO_2$  for a given energy output compared to their current combustion with the same energy output. The additional problem of  $CO_2$  separation and recycling in an environmentally acceptable form, which is expected to mandate investments of the order of billions of dollars, has been identified but not addressed in this paper because requiring separate studies.

In closing, let us recall the lack of achievement of new clean nuclear or other energies in the past seventy years of

research despite the use of billions of dollars of public funds. The studies reported in this paper [7]-[72] establish that our alarming environmental problems cannot be solved with 20th century sciences, and require basically new mathematics, physics and chemistry.

This is due to the fact that 20th century sciences, including Einstein's theories, quantum mechanics and quantum chemistry, were conceived for, and are solely applicable to systems reversible over time (such as the hydrogen atom, particles in accelerators, etc.), while all energy releasing processes are irreversible over time, in addition to other structural insufficiencies (Section II) requiring the surpassing of 20th century theories in favor of suitable covering theories.

Therefore, in the author's view and experience, the inability by our society to solve alarming environmental problems is primarily due to the suppression of scientific democracy for qualified inquiries orchestrated by the academic-governmental complex.

## ACKNOWLEDGMENTS

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<http://www.i-b-r.org/Dr-R-M-Santilli-Bio-1-10-18.pdf>