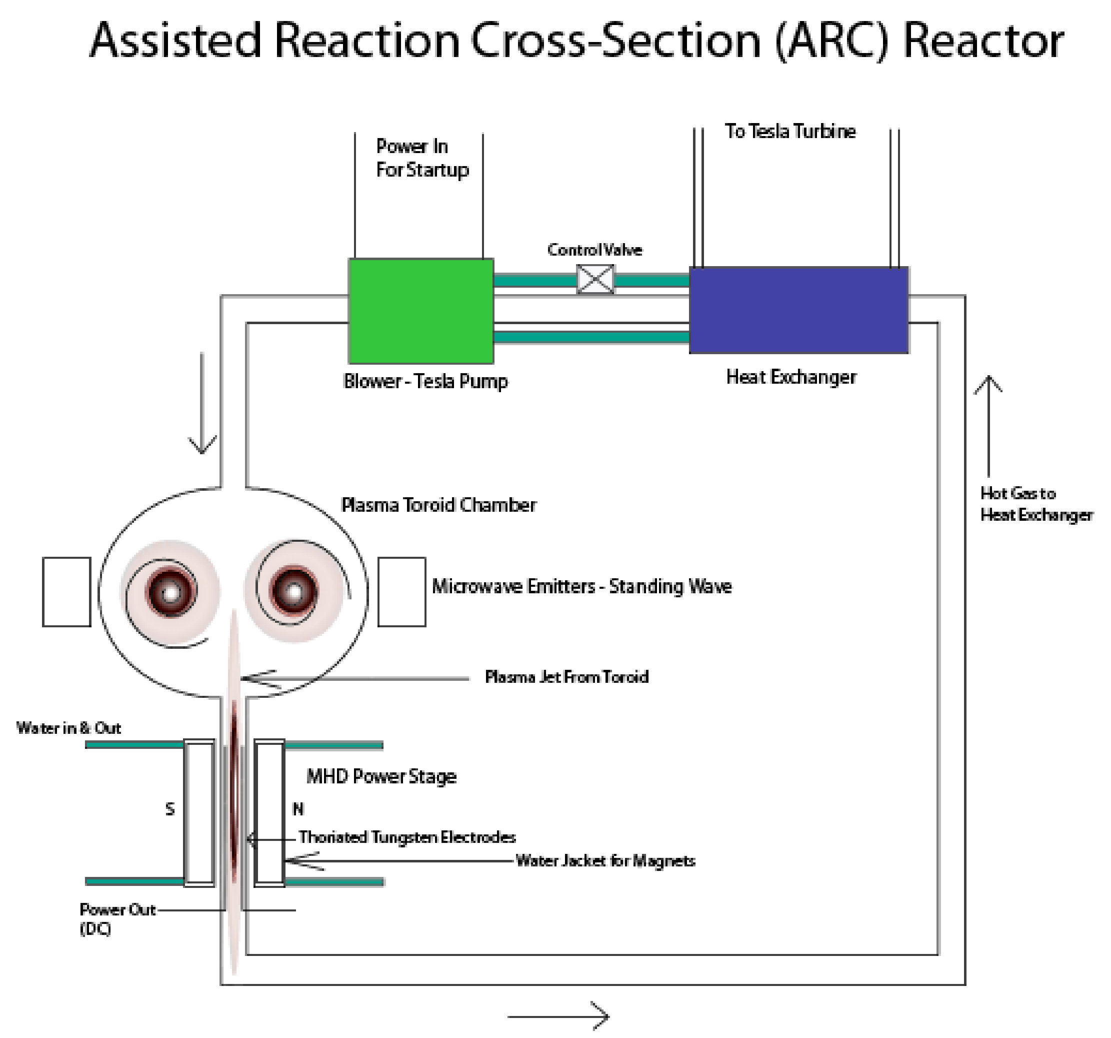

Description of the Assisted Reaction Cross-Section (ARC) Reactor

Bill Donavan 2012

For Implosion Group - Project with Dan Winter and Partners.

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This project consists of two "dusts", nanoscopic in size, which are synergistic in their reaction. The reactions take place in a plasma state in reduced pressure hydrogen, the optimal pressure of which has yet to be determined.

Stage 1: Plasma Chamber

The reaction begins in a chamber shaped like an oblate spheroid named the Plasma chamber. The geometry of this chamber is shaped so that a toroid is formed within in continuous involute (smoke ring) rotation. The ground-breaking research for this was done by Robert Golka, in The Tesla Project, and Bogdan Maglitch who proposed this in his paper on Migma. The anecdotal history of plasma toroids, or as some have called them, spheroids, comes from ball lightning research. The ball lightning phenomenon attracted curiosity in a great many people as to it's seeming ability to self-sustain, that is, the electric and magnetic fields of the involute rotation tends to produce a containment or confinement for the plasma, preventing its dissipation. This effect is replicated in the chamber, and the flow into and out of the chamber of the hydrogen/carbon/nickel mix with microwave excitation produces a jet of high energy, although unstable, plasma that is directed into the next chamber. This concept is also based on Professor Egley's work on carbon dust nano fusion. While we respect Mr. Egley's ground breaking work, we feel that the next step in the evolution of the technology is necessary. The reaction in the chamber is twofold:

1) Under excitation of the nickel with the microwave EM flux, the nickel reacts with the hydrogen. The EM frequency is tuned so that it reacts with both the carbon as well as the hydrogen. A mix of frequencies can also be used, each tuned to excite the hydrogen, carbon and nickel into meta-stable states. The hydrogen is lifted into a high energy state, and becomes ionized. The EM mix acts as a "jammer" disrupting the coulomb barrier of the nickel, and causing an LENR reaction to take place. This reaction produces beta particles that further ionize the gas/metal mix. The nickel is irreversibly converted to copper. Further reactions may take place to convert the copper.

2) The carbon reacts with the beta particles, absorbing the flux into the nucleus. One beta is sufficient to temporarily convert the carbon into boron in a k-capture reaction. The half life of this highly unstable isotope is 20.20 milliseconds, and the output of this is a beta particle that tends to have a higher energy than the original excitation beta flux. Another side reaction is a 1.58% decay of the excited boron 12, which produces three alpha particles, or helium nuclei.

With the double reaction of these two elements, the energy of the original nickel-hydrogen reaction is boosted. The volume of the initial plasma chamber is anticipated to be in the order of 50 cubic centimeters to start. This is scalable to whatever size is needed without a loss of regulation, as the toroidal rotation provides this point of regulation.

However, some details need to be discussed about the hydrogen/nickel LENR reaction, as it is quite complicated, ping-ponging between nickel and copper several times before it stabilizes. The most abundant isotope of nickel is 58, at an abundance of 68%. There are four others: 60, 61, 62 and 64. The reaction goes through all of these isotopes before it finally reaches copper. The first reaction is copper 59, which has a half-life of 81 seconds, undergoing electron capture and becoming nickel 59. Now nickel 59 is not stable having a half-life of 76,000 years, and left alone would decay through electron capture into Cobalt 59 with subsequent soft-x-ray emission. However, this does not happen, and nickel 59 converts through non-coulomb proton absorption into copper 60. This isotope is also very unstable, with a half-life of 23.7 minutes, and decays through electron capture and x-ray emission into nickel 60. This isotope is stable. It once again absorbs/fuses with another proton into copper 61. This isotope is not stable, and once again decays through electron capture and x-ray emission into nickel 61, which is stable. This isotope absorbs/fuses with another proton to form copper 62, which has a half-life of 9.62 minutes, decaying into nickel 62, a stable isotope. This absorbs/ fuses with another proton to form copper 63, finally a stable isotope of copper.

But what about the remaining two isotopes of nickel? Let's take a look. Nickel 62 absorbs/fuses with a proton to become copper 63, a stable isotope of this element. Nickel 64 absorbs/fuses with a proton to become copper 65, also stable. How likely is this to happen? Nickel 62 has a relative abundance of 3.634%, and nickel 64 is 0.926%. So the most likely one to begin with is nickel 58, with the Peyton Place of nuclear reactions to deal with. The problem is that if someone was unfortunate enough to open up one of the reaction capsules just after a shutdown, they would notice a seething mass of radioactive copper and nickel isotopes undergoing electron capture and conversion. The only way around this is isotope separation, and using isotopes 62 & 64 of nickel. That way, if there were a core broach, the room would not become flooded with radiation. I think that a lot of researchers have technical myopia, and look at the short-term results, and profits rather than planning a long term strategy. That is what needs to be done. Let us continue with the analysis.

Stage 2: MHD Conversion

This stage is where the plasma plume, or jet, after compressing in the center of the torus, and receiving the massive beta and photon flux in the center, is raised to a meta-stable state, and exits the plasma chamber. It goes into a tube where it cuts across a large magnitude magnetic flux, generating a DC voltage across it in the process. Thoriated tungsten power take off electrodes utilize this voltage and current and input that into an inverter, producing AC power. The MHD magnets are cooled with a water jacket, and a fan cooled heat exchanger. This heat exchanger and feedwater pump are not shown in the diagram. Dr. Elizabeth Rauscher, an expert in plasma physics as well as MHD technology, is on our team and she will be heading up the section on MHD conversion.

Stage 3: Heat Exchanger/Intercooler

This stage cools the hot gas and recovers the thermal energy for co-generation using various modalities. This gas temperature is anticipated to be in excess of 600 degrees Celsius. These variants are considered:

1) Tesla turbine conversion using Rankine cycle, where the heat exchanger boils a working fluid into steam, and that steam turns a turbine that turns a conventional alternator. Various claims have been made for efficiencies of thid turbine ranging from 60% in the original 1911 work to 80% by Frank Germano. If we take the median of the two, at 70%, and apply this to a high efficiency alternator of 80%, then the product of the two will be 56%. This will be our anticipated co-generation efficiency of this particular configuation.

2) Tesla turbine using high-pressure gas. This system runs on the Stirling cycle, and as such uses no change of phase, remaining in the gas phase. The exhaust gas is circulated in a heat exchanger to cool it down before it goes to the intercooler and back to the turbine. This is a closed loop system, and the mechanical output of the turbine goes to a high-speed alternator.

3) Thermoelectric/thermionic conversion and heat exchange. Since the primary reason for the heat exchanger is to cool the gas before it reaches the recirculating blower, this one would output the electrical power to a motor running the blower, instead of using a mechanical output. Since it is anticipated that a starting motor will be needed for the blower, this simplifies the system. However, the overall efficiency for this variant is approximately 20-30%, and the only merit is in its solid-state configuration.

The overall efficiencies for a system using co-generation are quite impressive. For example, if the MHD stage is running at 50% efficiency, and the co-generation side at 30%, then the overall would be 80%. This would be a gross output, minus the 10% loop back into the system, which gives us a net of 70%.

Stage 4: The Blower

This is the last stage before the process material goes back into the plasma ignition chamber. The blower does exactly just that: it blows the material through the system at a predetermined rate of volume. It is analogous to a feed water pump in a steam generator. However, the difference is in that there is no change of phase, and it operates at reduced pressure, making the possibility of the unit operating off a thermal differential less likely. So therefore, a “blower” is needed. This stage is mechanical, and not very tolerant of high temperatures, so it is placed after the intercooler/heat exchanger. This component can operate off it’s own Tesla turbine, and on the diagram we see it routed to the heat exchanger configured as a boiler. In line with the turbine is an electric motor used for startup. Once the system comes up to temperature, then the turbine system takes over. A speed regulation system with the turbine regulates the volume of reaction materials suspended in the gas, and thus the reaction cross-section moving through the plasma chamber. If the gas volume decreases to a critical level, then there will be the risk of carbon dropping out and coating the walls of the plasma conduit connecting independent elements of the system. This is another reason to combine the carbon nano powder with either nickel, or nickel and lithium.

Overview of Operation

The nano powder suspended in the hydrogen gas is pumped into the plasma chamber, which is irradiated with microwave emitters on either side. Due to the high conductivity of the materials suspended in the gas, a current is generated that moves within the chamber, igniting the plasma. This plasma reacts with the nickel 62 producing copper 63 the byproduct of soft x-rays and beta particles (electrons), which interact with the carbon. This element has two stable isotopes, 12 and 13. Carbon 13 has a natural abundance of 1.11%, and no branching percentage that causes the triple alpha emission. It simply ping-pongs back and forth from carbon to boron to carbon. Estimates of the triple alpha emission indicate that the energy involved is in the order of 72 megawatts per gram. This is lower than the nickel-hydrogen fusion reaction, which is the secondary source of energy in the system, which is 164.32 megawatts per gram. Lithium 7 can be also added as a side reactant, as when it undergoes non-coulomb absorption with hydrogen (proton) it becomes beryllium 8, which undergoes double alpha emission. Since this additive is optional, it will be outside the scope of the analysis.

Dr. Bogdan Maglitch has done extensive modeling and research into the toroidal containment system, calling it “Migma” fusion. He built a demo unit, but could not gain interest in funding his program. Elizabeth Rauscher has experience with the tokamak fusion system (toroidal compression fusion geometry), which is close to this concept, and is on our team. While the tokamak used plasmas in the millions of degrees Kelvin with its associated containment problems, catalyzed fusion plasmas are in the thousands of degrees, and far more controllable. This is to our advantage.

A plasma jet leaves the center of the toroid in the plasma chamber, and enters the MHD generator stage, producing a direct current output. The plasma then extinguishes, and a hot gas then enters a heat exchanger/intercooler. The heat from this gas is used in co-generation, and then the gas/particulate mix enters the booster/blower stage, pushing the material back into the plasma chamber, completing the cycle.

Advantages

The system is more versatile than solid-state in that regulation is simpler, with the reactant material moving through an ignition/excitation zone rather than staying in one place. Stationary plasma compression suffers from nonlinearities that create hot spots, which have destroyed containment vessels. This has been seen in both hot as well as intermediate plasma catalyzed fusion. It also solves the regulation problem, as the reactants are in cross-section for a brief period of time, and any nonlinear events are purged out of the plasma chamber during operation. Also, it allows the use of MHD for power conversion as a primary method, with co-generation taking the balance.

Disadvantages

A combination of different disciplines requires a team to do this, and to work together cooperatively. Also, many of these elements have been tried experimentally, although in separate systems. Combining these may lead to different problems that must be worked through. This amalgam of technologies is together unproven, although it shows great promise.

Conclusion

A system for catalyzed fusion is offered, and the operational parameters lie between standard LENR and “hot” fusion. A combination of different technologies is also offered to solve the problems inherent in both. This is a hybrid system, with no new technologies but an assemblage of known mature tech.