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# Novel Application of High Voltage Electrostatics Corona Ions Discharge Related to Treatment, Sanitization and Disinfection of Biological Matter Such HIV-AIDS Infected Blood

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**Abstract:** A novel high-voltage electrostatics corona ions pre-charger apparatus and methods were invented earlier by Hamade related to treat various types of receptors such as but not limited to electret polymer, air filters, particulates, catalytic converters, bioaerosols, fluids, pollutants, virus, and bacteria. It is shown in this article that his work led to the construction of various prototype chargers, customized differently for each type of a receptor. In particular his recent development of biological matter corona charger (BMCC) prototype related to expose, treat, sanitize, and disinfect bioaerosols, virus, bacteria, and contaminated fluids and blood such as human immunodeficiency virus (HIV) - acquired immune deficiency syndrome (AIDS). It is shown in this paper that each previous investigated research contemplated ionized corona charger attendant to a charging process and the corona, imparts and provides enough treatment charges to receptors including the aforementioned receptors. Researchers often relied on adopting prior corona charger methods that do not necessarily and effectively solve the problems associated with them or utilize them for optimum treatment effect. The inventor exhaustively studied the characteristics of corona discharge, and has found that the greatest difficulty in corona discharge has to do with the maintenance of the corona, particularly when the receptor is being charged. This is due to variations in either the dielectric value between the corona electrode and a grounded base or flaws in the design as the receptor passes there between suppressing or hindering corona and its effectiveness. What is needed in-the-art is an apparatus and method to achieve maximum possible charge on a receptor, a charge order of magnitude greater than that used by other investigators. This often requires customizing each apparatus and method and does not just merely use one type of a charger to satisfy all applications. To satisfy this need, we build a low cost prototype BMCC that generates self-sustaining charge corona, eliminates many previous design flaws such as spark over, and make it ready for testing remotely or with apparatus.

**Key words:** high voltage, corona ions discharge, disinfection, acquired immune deficiency syndrome (AIDS), infected blood, electret, emission catalytic converter
**CLC number:** T-18 **Document code:** A

## 0 Introduction

It has been known that corona charge and electrical fields can be utilized in various applications to impart charge into receptors for various treatment purposes. This is similar to the common applications of laser, except that conventional chargers and electrical fields are intruded with the presence of a receptor, while laser radiation zaps a receptor without the receptor affecting the radiation source. Early on, Hamade[1] realized the need of developing a corona and high voltage electrical field that can genuinely affect a receptor but without the receptor affecting and intruding the charger or the electrical field (similarly to using laser non-intrusively). Even with and without such development, corona and high voltage electrical fields are commonly used in research and fabrications to treat receptors, such as electret fabrication, in printing, air filtration, bioaerosols, biological and contaminated blood fluids treatment, catalytic and chemical conversions, and so on.

What remained in the art was to develop sources of corona charger and electrical fields that would deliver maximum charge on a receptor with tasks to keep the sources unaffected, self-sustainable, can be controlled and used stationary or remotely, deliver optimum charge, and be free from flaws that can cause spark over, electrical short and hazards. These seem impossible tasks to accomplish in one prototype, however,

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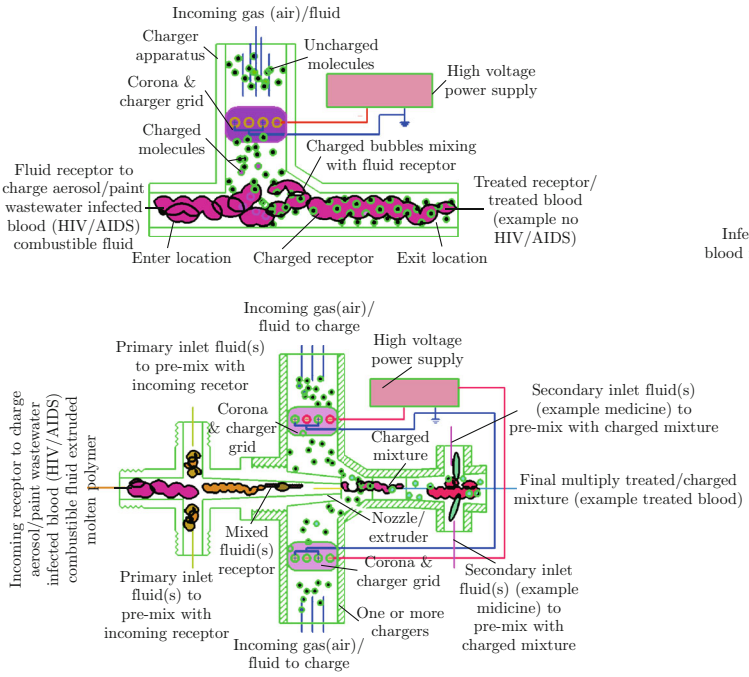
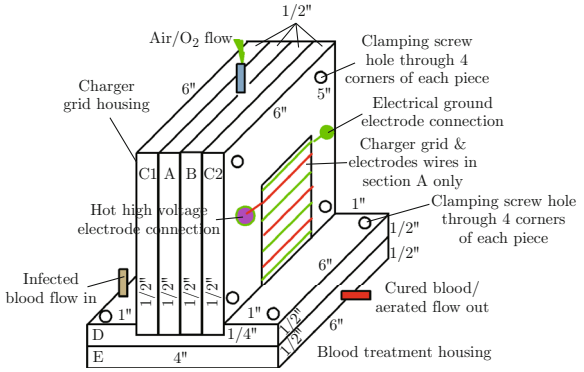
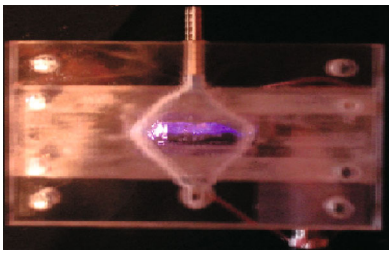
our exhaustive investigations showed that many of such tasks can be achieved by carefully balancing research concepts with practice and come up with a genuine effective workable prototype. As an example, Fig. 1(a) shows our patented[1] concept view (sketch) of biological matter corona charger (BMCC), Fig. 1(b) shows conversion of concept to design (1 inch ($1''$) = 2.54 cm), and Fig. 1(c) shows the constructed prototype in action creating air corona ions that transported into a receptor treatment section. In Fig. 1(c) air was the receptor which would be substituted by biological fluid to mix with the blown corona ions. In either view, the receptor does not intrude the charger section, however, corona charges (ions) can be transported innovatively into the receptor without affecting the self-sustaining corona generator (charger electrode wires).




(a) Inception view




(b) AutoCAD design for the inception view



(c) Actual bottom view of corona action with air (no biological matter ever tested)

Fig. 1 Biological matter corona charger perception as shown by the invention[1]

The schematics and photo in Fig. 1 are simulated views where no actual receptor was present and no activities were ever conducted with any biological matter since this part of testing is to be left to qualified medical researchers. The inventor[1] is the author of this paper and only had to relate the invention to treatment of biological substances to get the patent, and such treatment is not recommended. Also, it is beyond the scope of this paper to conduct medical research and treatment of biological matter.

We developed novel charger designs that can be stacked to deliver 3-dimensional corona fields to engulf a receptor (such as an auto exhaust catalytic converter[2]) for maximum treatment without suppressing the corona source[1-3]. We built prototypes where the charger and electrical fields sections can be attached or detached from the receptor housing (in case of needed maintenance and reuse). The developed prototypes can be adopted remotely or intimately with an apparatus for the treatment of receptors. Some of the work published and patented[1-3], while other designed prototypes are still to be investigated for diverse applications related to treatment of receptors.

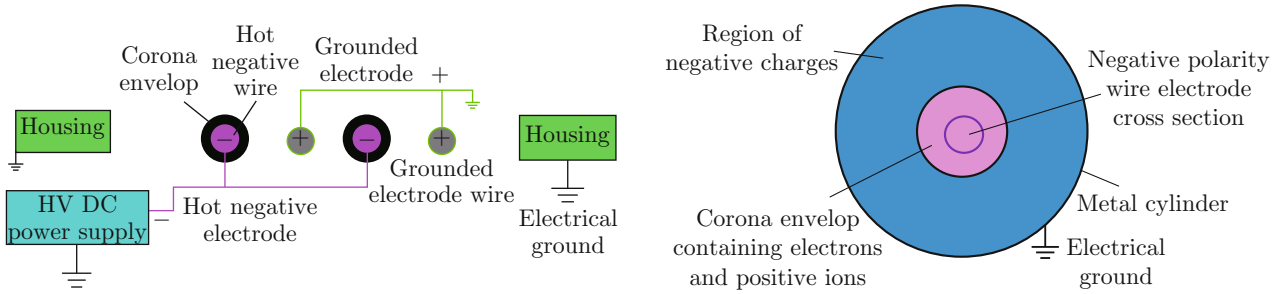
All the references in this paper used corona and electrical fields to treat some sort of a receptor. Important applications relating corona and electrical fields to treat and disinfect receptors include: bioaerosols, bacteria, viruses, and contaminated blood with human immunodeficiency virus (HIV) - acquired immune deficiency syndrome (AIDS). AIDS, first reported in the early 1980s, has been a center of concern in global and has taken the lives of almost 25 million people. Its etiological agent HIV is threatening over 60 million persons who have been infected and even more people with infection[4]. A vast number of researchers developed apparatuses and methods to treat and disinfect the HIV-AIDS, in particular the use of corona and electrical fields for such treatments and for disinfecting other viruses, bacteria, and biological substances. In this paper we investigated apparatuses and

methods seldom used by researchers to show the benefits and the flaws in adopting their methods to treat biological matters with corona ions. In References [5-9], the apparatus showed a biological receptor intruding the charger source, hindering the charger effectiveness in treating the receptor. While our BMCC apparatus (see Fig. 1) was designed to prevent such intrusion to treat receptors more effectively than the intruded case and to provide self-sustaining coronas, which do not get diminished by a receptor.

## 1 Description of Prior Work

### 1.1 Corona and Electrical Field Mechanisms

The first book about this work can be found by White[10] when he attempted to electrically separate particles from gases using negative corona discharge from a wire. However, no precise theory is found in literature describing transport corona for multiple wire corona chargers such as those deployed in our work. How corona ions interact with other matter such as a receptor is more complicated to predict, particularly when electrical fields are applied in conjunction of the charger and a receptor matter. The theoretical work is beyond the scope of this paper. Hilczer and Malecki[11], and Moore[12] also investigated wire and sharp objects corona generation and transport. Most emitters use positive (+) polarity because corona ions are more stable than the case when negative (−) polarity emitters are used. More complicated process is involved when a negative polarity emitter is used to cause similar ionization of gas molecules but a much more complicated process is involved with secondary electron emissions made possible by increases in the charge intensity[12]. Positive polarity emitters are selected and emphasized in previous work because they have the ability to hold much higher currents and voltages for charging[10]. As far as we know the construction of an effective charger that treats a receptor matter is the art of our work. Construct chargers with alternated polarity of grid wires between (+) and (−) as shown in Fig. 2. Reverting the design to another uniform polarity electrodes of (+) or (−) polarity is easy. This creates an optimum operating environment for treatment of a receptor since we are able to separate the charger wire grid section from grounded surrounding to prevent spark over. Corona discharge and high voltage (HV) electrical fields are subjects of great interest for our applications because of their possible commercialization. Next sections demonstrate some of the applications.




(a) Hamade[2] multi-wire charger (b) White[5] single wire charger

Fig. 2 Corona charger wire patterns

### 1.2 Electrically Stimulated Filtration (ESF) Corona and Electrical Field Effects on Air Filters

Masuda[13], Jaisinghani and Hamade[14], investigated corona and electrical fields influence on gaseous fluids (mainly air), with or without pollutants such as suspended aerosol particles and particulates in the open and across air filtration media. They concluded that exact theory and mechanisms on how electrical fields and corona presence treated receptors such as aerosol and air pollutants, are complicated to predict. Their multi-wire two dimensional corona field chargers outperform the charging effect of single wire and the charger performance of Masuda. Jaisinghani et al.[14-16] and Kuplicki[17], also concluded that dielectric receptors such as dioctyl phthalate (DOP) aerosol particles are more susceptible to be charged from corona ions than the polarization of electrical field. Jaisinghani et al.[14-16] showed that an ESF apparatus produced the greatest filtration efficiency when compared with similar test but in the absence of the electrical stimulation. Their ESF apparatus involved the positioning of multi-wire grid charger upstream of a filter and the filter sandwiched between two opposite polarity perforated metals electrodes connected to the same power source as the charger.

Their ESF produced high filtration efficiency compared to similar tests without electrical enhancements. This work showed that ordinary filter efficiency can be enhanced to be as effective as a high efficiency penetration air (HEPA) filter but much less pressure loss and longer lifetime before replacement. The ESF work solved many grid design problems and many flaws in previous designs, spark over, minimized effect of

humidity on power consumption by insulating the filter media from the electrodes, and optimized charger design but the charger wires had the same polarity. A typical ESF test apparatus is shown in Fig. 3.

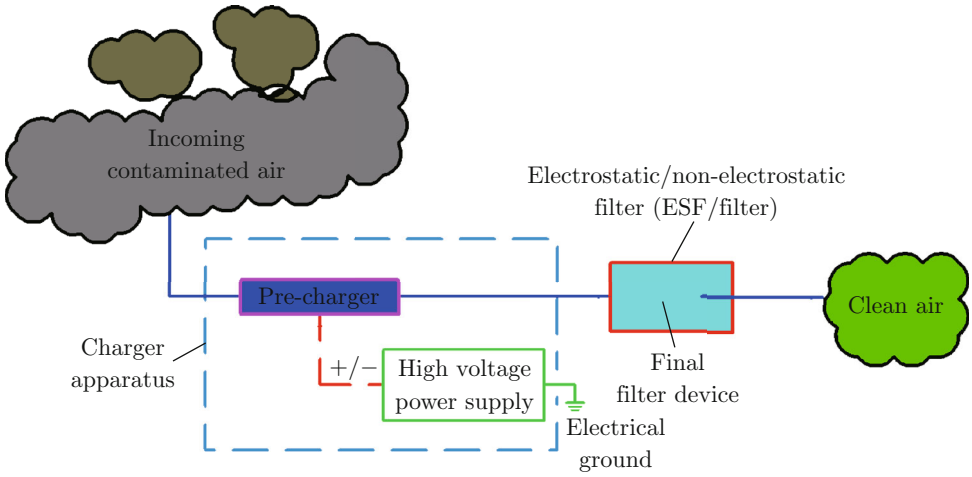



Fig. 3 Typical ESF test apparatus (electrodes powering ESF filter not shown)

Later, Hamade[1] and Kuplicki[17] found alternative wire grid design that outperforms the prior ESF chargers and gives better insight on optimizing corona chargers in treating a receptor such as an aerosol. We practically adopted their charger technique but innovatively converted the charger concept for the treatment of different receptors such as those deployed in enhancing a catalytic converter or making an electret.

### 1.3 Novel Electrically Stimulated Catalytic Converter (NESCC)

In automobile vehicle exhaust systems, catalytic converters are widely used to reduce unwanted emissions from internal combustion engines but they are bulky and expensive. Catalytic converters are also used on many engine-equipped machines including generator sets, forklifts, mining equipment, trucks, busses, trains, etc., to treat the exhaust from engines of these machines and to reduce pollutants. Since our chargers in the patent were designed and modeled to treat a receptor matter during fabrication of electret material (see next section), this work was extended to treat an automobile catalytic converter with corona.

A conventional catalytic converter was electrically stimulated with corona using a novel prototype that was built recently but described as a concept design in the granted patent[2]. The prototype has commercialization potential since it relates to reduction in auto exhaust emission relative to conventional converters, reduction in size, weight, and pressure loss across the converter. Also, the prototype development can be seen in the patent review paper was submitted for pending publication with this paper[18]. The novel constructed prototype resulting from exhausted efforts in converting a concept patented[2] design (Fig. 4(a)) to practical auto computer-aided design (CAD) design ((Fig. 4(b)), is then followed by an actually constructed prototype (Fig. 4(c)).

### 1.4 Fabrication of Electret

Electret fibers are commonly used to replace HEPA filters because of their lower pressure loss and enhanced filtration efficiency. They are commonly used in cigarettes as filters and also in hospitals as surgical masks. Conventional fabrication includes charging a dielectric polymer (plastic) such as Teflon with corona ions or an energy radiation source. Depending on the charger application and on the electric properties of the polymer, treated polymers tend to hold an electric charge that is much greater than the triboelectric static charge. So, electrets have potential in many commercial products. Electret charge mechanism, how electret fibers capture aerosol and pollutants, and electret commercialization can be found in literature[5,19-21].

Our invention described a novel apparatus that was used to generate an electret. The same concept apparatus was also used to treat receptors in general such as the catalytic converters or for use with BMCC.

Hamade and Pickwick[19,22] showed that their corona chargers can be more effective in charging electrets than conventional corona charge methods since the electret receptor does not intrude the charger section and thus avoids suppressing the corona. A typical schematic for the charging apparatus is shown by Fig. 5(a). In the apparatus, corona was blown over the surface of an electret polymer to be treated, in a way as to prevent the polymer from suppressing corona. This was a clear advantage over conventional electret corona charging methods that fed the electret between corona electrode wire and its electrode collector, suppressing corona depicted by view of Fig. 5(b).