The Use of Cold Plasma in Hand Sanitization

By
Abdullah Olgun
Submitted on 2 July 2024

1. Participation Type- Please select how you are participating in this challenge.

Solver (Individual)

2. Category of solution – please choose either category 1 (novel designs and innovative solutions), or category 2 (existing technologies, solutions, and potential partners).

2. Existing technologies, solutions, and potential partners

3. Solution Level - please confirm the Technology Readiness Level (TRL) of your proposal: TRL1-3 ideation, TRL4-6 proof of concept, TRL7-9 production ready.

TRL7-9 production ready

4. Problem & Opportunity - highlight the innovation in your approach to the Problem, its point of difference, and the specific advantages/benefits this brings (up to 500 words).

My solution that can address this challenge is the application of reactive products generated from atmospheric air activated through the use of cold plasma. Cold plasma's charged particles perforate/destruct the cell membranes of microorganisms. This process does not harm human cells, as enzymes within the body break down the cold plasma and protect the cells.

Over the past few years, plasma medicine has become an important field. Cold plasma has proven antimicrobial effects.

Ionized gas (plasma) is a gas in which a part of the molecules are ionized, that is, deprived of an electron. Therefore, there is a mixture of neutral molecules, ions and electrons. Plasma, the fourth state of matter, is generated by an electric discharge that ionizes an inert gas such as air in a controlled and safe way. Using appropriate measures, it is possible to make the devices used completely electrically safe and limit the power so as not to heat the gas. Among the salient characteristics of ionized gases are luminescence and the property of conducting electricity. The consequence of ionization on oxygen and nitrogen, charged and reactive molecules present in the air, causes peroxidation. In this way, the ionized gas destroys viruses, bacteria and fungi, without any side effects for human cells.

Several studies have demonstrated that ionized gases have various applications in the medical and health fields . In addition to being effective in disinfecting viruses, fungi and bacteria , they accelerate wound healing and blood clotting. Ionized gases are used to treat some skin conditions such as burns, sores and wounds, they promote healing of skin tissue and alleviate inflammatory reactions. This makes ionized gas ideal for sanitizing hands, even in the case of wounds or scratches. It can also be used on abraded, burned skin or skin affected by psoriasis or vitiligo.

In a study to test the decontamination power of two cold plasma sources [low-temperature atmospheric pressure plasma jet (APPJ) and dielectric barrier discharge plasma (DBD)] in vivo on human fingertips; both plasma devices led to a significant reduction in of physiological and artificially contaminated flora. Treatment with both devices was well tolerated. No plasma-resistant isolates were observed (Daeschlein 2012). Cold plasma appears to have potential for skin disinfection.

5. Solution Overview – Please ensure that you describe the features of your proposal and how they address the SOLUTION REQUIREMENTS in the fields relevant to your category (up to 500 words).

Solution requirements (R) and how I address (A) them:

- R: Effectiveness
- A: The proof of concept and effectiveness of the proposed approach was tested for a similar patented device (Glow). The certified efficacy was reported as 99.9% on viruses, fungi and bacteria .

- R: To reduce the risk of HAIs by improving hand hygiene compliance and adherence
- A: The device is compact , versatile, handy, easy and intuitive to use . Just inserting hands into the special sanitizing drawer and waiting for the luminescence to turn off is enough. This way it can be sure of having sanitation and perfectly dry hands .

- R: Value for money –it does not exceed the maximum of 25 USD per healthcare worker per year.
- A: The device can have zero waste. It will not require any costs for consumables or ordinary maintenance. It can be built with 100% recyclable materials. It will have a very low electricity consumption. It can also be used/shared by many health professionals who share the same room. It can be produced by mass production with very low prices. For example, a similar device (Glow) has a reported price of 500 USD. Thanks to mass production, with a reduced price (i.e. 200 USD) a health professional can use it for a minimum of 10 years with a yearly cost of ~20 USD.

- R: Accessibility
- A: My solution will improve the ability to meet the WHO 5 Moments for hand hygiene even in environments without water and other consumables. Just an access to an electricity source will be enough. In just a few seconds, it will guarantee sanitization of up to 99.9% from viruses, fungi and bacteria not only on the skin but also under the nails, where viruses often settle. The disinfection process will end automatically leaving the hands dry and protected. It can assure an unprecedented user experience.

- R: Convenience
- A: My solution can be used during tens of years with ease and convenience.

- R: Behavioral elements –
- A: It will be able to affect healthcare workers' long-term compliance and adherence thanks to its ergonomical design, ease of use and very short desinfection time. It can also provide feed-back signal to improve adherence when the device is not used in any of WHO 5 Moments.

- R: Nice-to-have criteria: Possibility to measure hand hygiene compliance
- A: With an easy algorithm or app it can measure hand hygiene compliance using the WHO 5 Moments. For example, an app can detect and record if the device is used when health rpofessional enters the patient zone, or when he/she stands up to approach patient etc.

6. Experience - Expertise, use cases and skills you or your organization have in relation to your proposed solution. The IRC may wish to partner at the conclusion of the Challenge; please include a statement describing your expertise and indicating your interest in volunteering towards realizing your prototype solution (up to 500 words).

I am a medical doctor and professor of medical biochemistry. I won several awards. I developed and commercialized innovative medical products that meet large unmet needs. I am interested in volunteering towards realizing my solution.

7. Solution Risks - any risks you see with your solution and how you would plan for this (up to 500 words).

I couldn't find any risks of my solution despite intense literature search. Only general risks seen in electrical utensils can be encountered. These risks can be prevented by quality manufacturing.

8. Timeline, capability and costs - describe what you think is required to deliver the solution, estimated time and cost – please note the cost constraints of 25 USD per healthcare worker per year for already existing technologies/solutions and the cost

constraint of 66 USD per healthcare worker per year for novel solutions, technologies, or concepts/designs. (up to 500 words).

The proposed device can be mass produced in a very short time period with very low prices. For example, a similar device (Glow) has a reported price of 500 USD. Thanks to mass production, with a reduced price (i.e. 200 USD) a health professional can use it for a minimum of 10 years with a yearly cost of ~20 USD. It requires no consumables or maintenance costs.

9. Online References - provide links to any publications, articles or press releases of relevance (up to 500 words).

- Daeschlein G, Scholz S, Ahmed R, von Woedtke T, Haase H, Niggemeier M, Kindel E, Brandenburg R, Weltmann KD, Juenger M. Skin decontamination by low-temperature atmospheric pressure plasma jet and dielectric barrier discharge plasma. J Hosp Infect. 2012 Jul;81(3):177-83. doi: 10.1016/j.jhin.2012.02.012. Epub 2012 Jun 8. PMID: 22682918.
- Schaal, T., Schmelz, U. Plasma disinfection procedures for surfaces in emergency service vehicles: a field trial at the German Red Cross. Sci Rep 13, 20737 (2023).

Web page links:
https://www.htplasma.com/
https://www.youtube.com/watch?v=7rfFz6uJnZY&t=3s

10. How did you find this Challenge? – please indicate what drew you to this Challenge, including any relevant advertising or marketing that you followed to this Challenge.

I routinely check Wazoku web page. When I saw this challenge, I thought that I can have a solution, and worked on it. After attempting many original ideas (i.e. using multilayered gloves made of thinnest fabric), I decided to work on plasma technology that I also use for cold sterilazition of other materials.