

Nitric oxide plasma sources for bio-decontamination and plasma therapy

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Résumé

One of the main products generated in atmospheric plasma sources is nitric oxide. The nitric oxide molecule is known as anti-bacterial agent from one side and the molecule providing signaling and regulation biological functions from the other side. Some applications of nitric oxide plasma devices for sterilization and plasma therapy will be illustrated and discussed in the presentation.

Introduction

One of the most exciting medical discoveries of the 1980s in the study of human physiology was the realization that nitric oxide (NO) is a short-lived, endogenously produced gas that acts as a signalling molecule in the body. Signal transmission by a gas, produced by one cell, which penetrates membranes and regulates the function of other cells is an entirely new principle for signalling in the human organism. Today it is known that NO is also a universal anti-microbial factor and has important roles in the function of many tissues and organs, from the cardiovascular system to the brain.

Nitric oxide generation

Exogenous NO gas for bio-decontamination or therapeutic applications could be generated by several methods. The easiest way to obtain NO is chemical synthesis in the reaction of ammonia oxidation. However, the storage of chemically synthesized NO gas for further applications is a complicated problem because NO radicals are not stable and could be converted to NO₂ gas in the reaction of recombination in the presence of oxygen. That is why plasma chemical synthesis in the flow of atmospheric air could be an alternative method of NO generation for anti-bacterial and medical applications *in situ*.

Plasma device "Plason" based on arc discharge was developed for generation gas flow containing NO with different configurations of the exit channels corresponding to the different medical applications: blood coagulation, tissue destruction, therapeutic manipulator/stimulator. Plasma temperature and nitric oxide content at the anode exit differs in different configurations of the device, corresponding to different medical applications.

Anti-bacterial effect and nitric oxide plasma therapy

The great need of new anti-bacterial platform is determined by continues increase of multi-drug resistant bacteria. The new antibiotics are often far more expensive and more toxic than predecessors. In vitro investigation of the influence of NO on *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, and *Candida albicans*, which are typically associated with many hospital infections, showed that treatment by NO practically removes them all. NO could be used also to kill antibiotic-resistant, fungal (*Tinea Pedis*) and parasitic infections (*Leishmaniasis*).

Effectiveness of the plasma NO-therapy is already at present shown with a number of diseases in wound pathologies (trophic ulcers, diabetic foot ulcer), gynecology, traumatology, stomatology, ophthalmology, otorhinolaryngology, dermatology, gastroenterology, etc. Some new specific medical applications of the NO plasma systems will be described in the presentation.

References

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