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Plasma Modelling in Biomedicine: An Opinion

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Introduction

Plasma medicine research, which is now gaining traction, is multidisciplinary in nature, encompassing physical, chemical, and biological processes. Because of the synergy between experimental and theoretical/computational methodologies, rapid progress has been made in this sector. The combined use of diagnostic instruments and calculations leads to a better understanding of the mechanics of plasma-bio-object interaction. This article focuses on recent advances in plasma modelling for biomedical applications. These investigations used a variety of computational methodologies, which are explained. We present some modelling results related to the creation of reactive species by plasma and their distribution to bio-objects, as well as the effect of electroporation when cold plasma comes into direct contact with cells.

About the Study

Mechanisms of plasma

For biomedical applications, non-equilibrium (cold) atmospheric-pressure plasmas are gaining popularity. Neutral and charged reactive species, electric fields, and ultraviolet light can all operate on bio-objects in cold plasma (ultraviolet radiation). Plasma-produced reactive species (atoms, radicals, ions, and electrons) supplied to biological objects trigger a series of biochemical reactions in cells or tissues. The controlled transport of reactive species to the surface and interior of treated living tissue causes the biological response that is required: altered metabolism, planned cell death, and so on. Electric fields, which are powerful enough to promote pore creation in membranes in the process known as electroporation, may play a major and synergistic role in plasma-cell interactions when plasma is in direct contact with bio-objects [1].

Plasma sources

Most biomedical applications necessitate the employment of equipment that produce so-called cold plasma, which has a gas temperature that is just slightly higher than room temperature (by up to 10–20 K), allowing the plasma to contact bio-objects that are sensitive to heat. In collisions of hot electrons with gas molecules, cold plasma with low gas temperature and high electron temperature generates huge amounts of reactive species [2].

Volume dielectric barrier discharges (DBDs), atmospheric pressure plasma jets (APPJs), coronas, surface and microwave discharges, and other sources of cold plasma at atmospheric pressure have recently been developed. In open-air DBDs, discharge occurs at floating potential between a powered electrode covered by a dielectric layer and a treated item that serves as the second electrode [3]. A plasma-forming gas flows through a narrow dielectric tube in an APPJ, which is powered by repeating voltage pulses or sinusoidal alternating voltage at frequencies in the kilohertz or megahertz range, to generate a barrier or corona discharge.

During their transit to treated objects, the primary reactive species formed in plasma areas are involved in numerous chemical processes that generate a variety of secondary reactive species. To reach bio-objects, these species must pass through a layer of water-like bio-liquid, where chemical reactions in the liquid state yield a variety of watery reactive species. These species infiltrate living things and set in motion a series of metabolic reactions. All of these stages are studied in plasma investigations for biomedical purposes [4].

Production and transport of plasma

The majority of biomedical simulation results have come from the first two stages: plasma physics and gas phase chemistry. The first phase is discharge modelling, which is used to assess the plasma's properties. Modeling of chemical reactions in the discharge and its afterglow is based on the plasma properties obtained.

Many reactive oxygen and nitrogen-containing species (RONS) are formed when these primary species interact with air molecules: NO, NO_2, O_3, HO_2, HNO_2, HNO_3, $H2O_2$, and so on. The neutral reactive species produced in the discharges inside dielectric tubes or between bare electrodes in APPJs and microplasma jets fueled with He or Ar are mostly excited He and Ar atoms. The plasma-forming noble gases that emerge from the discharge zones mix with the surrounding air, where the major reactive species interact with air molecules, resulting in the generation of RONS through a cascade of chemical reactions. Ionization waves or directed streamers commonly propagate within and outside APPJs in dielectric tubes at repetition frequencies of applied voltage pulses in the kilohertz range [5].

Conflict of Interest

The author has no conflict of interest towards the article.

References

1. Engel, George L. "The need for a new medical model: a challenge for biomedicine." *Sci* 196 (1977): 129-136.
2. Clarke, Adele E., Janet K. Shim, Laura Mamo and Jennifer Ruth Fosket, et al. "Biomedicalization: Technoscientific transformations of health, illness, and US biomedicine." *Am Sociol Rev* (2003): 161-194.
3. Wainberg, Michael, Daniele Merico, Andrew Delong and Brendan J. Frey. "Deep learning in biomedicine." *Nat Biotechnol* 36 (2018): 829-838.
4. Street, Alice. "Biomedicine in an unstable place." In Biomedicine in an Unstable Place. Duke University Press, 2014.
5. Feng, Liangzhu and Zhuang Liu. "Graphene in biomedicine: opportunities and challenges." *Nanomed* 6 (2011): 317-324.

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