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In Focus: Plasma Medicine

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In Focus: Plasma Medicine

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This special issue of Biointerphases brings to the readership a collection of the latest research results in the nascent field of plasma medicine. Gas plasmas generate various reactive neutral and charged species as well as photons and electric fields. These are suspected or known to play the major roles in therapies that include treating infected tissue, wound healing, and cancer treatment, among many others. The field of plasma medicine also includes plasma processing of biomaterials and surfaces of medical equipment such as artificial bones, stents, and cell culture dishes. Research in plasma medicine has prompted renewed interest in old subfields, or even births of new subfields, of plasma physics, such as low-temperature atmospheric-pressure plasmas, plasma–liquid interaction, plasma–cell or tissue interactions, and plasma-enhanced chemical reactions in liquid. In this way, the guest editors view the field of "plasma medicine" not only as a set of potential technological innovations in medicine but also as a driving force for the development of new fields in science, especially in plasma physics.

Effects of reactive oxygen species and reactive nitrogen species on biological systems have been widely studied in biology and medicine, decades before gas plasma systems were introduced as potential medical devices. Endogenous reactive species have been known to strongly affect cellular homeostasis in their multiple roles in signaling, immune response and many other areas. Introduction or generation of exogenous reactive species as therapeutic agents is known to be part of some existing therapies. The introduction of gas-plasma based medical devices as sources of exogenous reactive species is expected to widen the window of such treatments, for example, by allowing relatively easy control of the dose and species composition. However, the fundamental challenges still lie in the fact that, at the moment, little is understood about how such chemically reactive species interact with biological systems and how they are generated, chemically converted, and transported in complex (mostly) liquid biological environments. Obviously, studies on such issues are not in the traditional realm of plasma physics. Interdisciplinary collaborations among physicists, engineers, chemists, biologists, and medical scientists must generate a substantial body of new knowledge associated with these inherently complex systems. The lack of such knowledge forces the developer of plasma medical devices to rely mostly on a relatively inefficient trial-and-error strategy for the time being. Fundamental interdisciplinary studies in the field are therefore urgently needed.

Plasma processing of biomaterials also concerns surface chemical reactions among chemically reactive species generated by plasma and surface materials, as in plasma processing of semiconductors. Unlike plasma processing of semiconductors, which has a long history of research and therefore has accumulated a wealth of data on their surface reactions, plasma processing of biomaterials still requires a better understanding of interactions of plasma-generated chemically reactive species with a variety of biocompatible materials. Again what ultimately matters here is how such plasma-treated biomaterials functions in biological environments, generally *in vivo*. This field of study also demands collaborations among experts in several disciplines including plasma science, materials science, bioengineering, and medicine.

This special issue presents state-of-the-art articles in various topics in plasma medicine that address these important challenges. As a discipline, plasma medicine is still in an exploratory, development stage. Currently accepted "truth" may well be contradicted in a few years. However, this dynamic state of the field may be what motivates and excites those working in plasma medicine. The guest editors hope that readers will enjoy reading articles of this special issue, finding them as informative, helpful, and most of all, exciting, as we did during the editing process.

Finally, we wish to thank all the authors for their contributions to this special issue as well as their diligent collaborations with the editorial staff to keep to deadlines. Special thanks also go to Anna Belu (Editor), Jennifer Schreiner (Editorial Assistant), and the many anonymous reviewers for their enormous efforts to help bring this special issue to fruition.

