

Editorial to the Special Issue on the “1st Young Professionals Workshop on Plasma Medicine 2012”

During the last decade the new field of plasma medicine—an interdisciplinary research topic connecting physics, biology, and medicine—has been established. The focus is set on the investigation of the complex interaction of nonequilibrium atmospheric pressure plasmas with living cells and organisms. Nonequilibrium plasmas generate chemically active species, electromagnetic fields, excited species, free radicals, and electrons and ions combined with photons ranging from infrared to visible light and to (V)UV radiation. The composition of these components depends on the feed gas and the plasma sources themselves since the mode of excitation and the feed gas composition strongly influence the amount of species found in the plasma. Besides gas composition, also the distance between sample and plasma source affects the biological impact due to temperature, but also due to the half-life or range of the reactive components.

The effective mechanisms of plasma treatment are mostly delivered via liquid systems so that studies have been extended to also cover the liquid phase surrounding the treated cells and tissues. Due to this, all four states of matter are included within the transdisciplinary research in plasma medicine, starting with plasma diagnostics in order to study the components directly formed in the active core of the plasma sources, followed by the gas phase which is strongly influenced by the ambient conditions and therefore contains a varying amount of excited species, radiation, and radicals. In order to get the comprehensive overview of the plasma components, time- and space-resolved diagnostics of plasma and gas phase such as (two-photon) laser induced fluorescence, optical emission spectroscopy, mass spectrometry, absorption spectroscopy from the infrared to the VUV, and many other techniques have been employed.

The interface between gas and liquids plays a major role in the understanding of the plasma-based effects on cells, since the cellular environment dramatically influences the composition of (second and third order of) plasma components in both quality and quantity. Therefore recent efforts were put on liquid diagnostics and radical chemistry employing techniques such as electron paramagnetic resonance spectroscopy

Up to now, reactive oxygen species (ROS) and reactive nitrogen species (RNS) in combination with excited species and UV radiation could be identified as the most relevant plasma components with respect to their influence on living matter, while the effect of electromagnetic fields still has to be determined. The biological effects have to be separated into two parts: influence on microorganisms, which mainly focuses on decontamination and sterilization processes, and on the other hand the plasma treatment of eukaryotic cells. While decontamination studies mainly focus on the killing of microorganisms, plasma treatment of eukaryotes displays a more complex spectrum of interaction possibilities, ranging from induction of apoptosis (programmed cell death)

to selective stimulation of certain cell populations. There is a wide variety of biological effects which strongly depend on the duration of the treatment itself, but also on the incubation time after the plasma treatment. The underlying mechanisms of ROS/RNS detoxification or repair mechanisms will be investigated by applying the latest OMICs technologies—starting from DNA microarrays and RT-PCR, over protein mass spectroscopy and phosphospecific western blots to whole cell assays to determine cell activities such as proliferation and cell cycle progression, as well as apoptotic events. The results indicate a strong influence of cold plasmas on the level of gene (in-)activation followed by protein modification and even the influence on cell metabolism and signaling molecules and the respective cascades they are involved in.

The aim of the “**Young Professionals Workshop on Plasma Medicine**” is to connect young scientists working in the new interdisciplinary field of science, to share results and problems, to open up the horizon, and to find a common scientific language between the different parts of life science and medicine in order to proceed with the successful story. It also is aimed at promoting young researchers in their career by improving their presentation skills in a relaxed atmosphere of like-minded people. The workshop will help to further connect scientists from physics, biology, pharmacy, and medicine in a completely new way of finding real interdisciplinary approaches to solve problems between the involved fields of life science and those who study the interaction of non-equilibrium plasmas with biologically relevant liquids and effects on cellular functions (see Fig. 1).

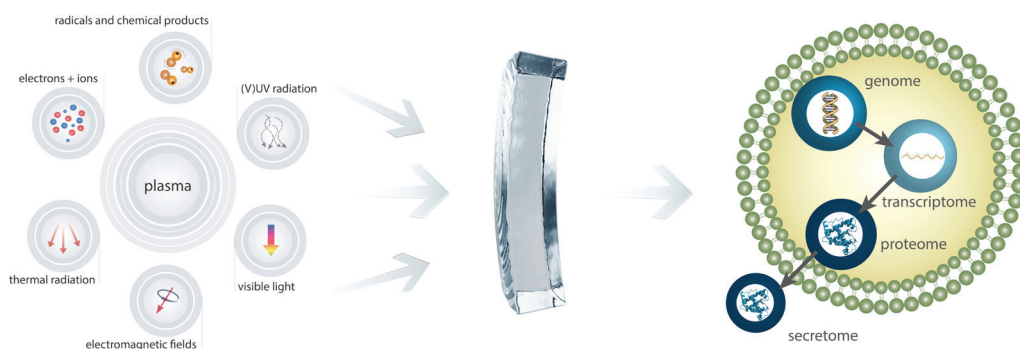


FIG 1: Plasma medicine requires a study of processes in the plasma, gas, and liquid phases. Transport and generation of reactive components through and in these phases are relevant to influencing the extra- and intracellular processes for inactivation and stimulation of prokaryotic and eukaryotic cells in order to disentangle the cellular effects of the primary plasma components and their consecutive products.

In this special issue, a broad overview of the topics of plasma medicine is given by the participants of the 1st Young Professionals Workshop on Plasma Medicine, which was held in Boltzenhagen, Germany, in September, 2012. More than 30 international early career scientists from nine institutes worldwide have presented and discussed their present results, some of which are collected in this special issue of *Plasma Medicine*.

Acknowledgment

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