SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and Development (3)

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ATMOSPHERIC PRESSURE PLASMAS – PAVING THE WAY FOR BIOMEDICAL TOOLS TO SUPPORT FUTURE EXPLORATION MISSIONS

Abstract

Recently, cold, non-equilibrium atmospheric pressure plasmas (CAPs) and their active chemistry have being widely investigated to the benefit of a wide array of applications: amongst many others, biomedical - as well industrial applications mainly in the area of materials processing and chemical synthesis . In general, these plasmas operate at standard conditions (STP), are small (cm) and rather simple to operate in comparison to other plasmas. Their complex chemistry gives rise to a wide array of both stable and transient reactive species: ranging from O3, H2O2, OH and NOx, next to charged species and (V)UV-radiation. As reported earlier, this chemistry already led to a broad range of industrial applications from waste water treatment, stain free detergents and industrial scale production of oxidants. This paper aims to highlight recent interesting biological applications such as disinfection, bleaching and wound healing. Bactericidal effects of CAPs gained increasing attention for applications such as dermatology, disinfection, dentistry or stimulated blood coagulation. Following up on results presented last year on using radiofrequency plasma jet for the inactivation of Pseudomonas auruginosas, new insight on the mechanism of the induced changes in the liquid chemistry by reactive species (OH, NO, O3) are presented. These changes lead to an increase in concentrations of molecules known to have bactericidal effects, such as HNO2, ONOO- and H2O2. Another promising application in the field of biomedical applications involves surface barrier discharges. Their physical construction, using floating or contained electrodes, offers a convenient way of controlling current for large scale, 3D treatment of both conducting and insulating surfaces with minimal heating. These devices may be tailored to specific skin treatments, allowing fast and effective treatment of larger skin surfaces while following the shape of the skin. These emerging technologies could be essential both for human health care during long term missions, as well as for research itself (planetary protection, sterilisation of tools and large areas, etc.). Especially in the absence of abundant resources (antibiotic agents, disinfectants and the like) alternative approaches to support humans in isolated locations have to be developed. Applications based on a good understanding of plasma chemistry would empower long term manned missions to efficiently use and manage in situ resources. Their low mass, compact size, low power consumption and high reliability could make them essential for human space exploration.