Plasma systems and processes for the containment of SARS-CoV-2 diffusion through bioaerosol and fomite routes

Romolo Laurita[1,2,3], Alina Bisag[1], Pasquale Isabelli[2], Cristiana Bucci[1,3,4], Filippo Capelli[1,2], Giorgio Dirani[6], Matteo Gherardi[1,2,3], Giulia Laghi[1], Alessandro Paglianti[7], Vittorio Sambri[6,8], Silvia Tappi[9,10], Pietro Rocculi[9,10], Elisabetta Suffredini[11], Vittorio Colombo[1,2,3,10]

Alma Mater Studiorum-Università di Bologna, Bologna Italy
[1] Department of Industrial Engineering, [2] AlmaPlasma s.r.l.,[3] Interdepartmental Center for Industrial Research Advanced Mechanical Engineering Applications and Materials Technology, [4] Department of Medical and Surgical Sciences, [5] Department of Pharmacy and Biotechnology, [6] Unit of Microbiology, The Great Romagna Hub Laboratory, 47822 Pievesestina (FC), Italy,[7] Civil, Chemical, Environmental, and Materials Engineering, [8] Department of Experimental, Diagnostic and Specialty Medicine,[9] Department of Agricultural and Food Sciences,[10] Interdepartmental Center for Industrial Research Agrifood,[11] National Institute of Health, Italy

E.mail: romolo.laurita@unibo.it

One of the major concerns in the current COVID-19 pandemic is related to the possible transmission in poorly ventilated spaces of SARS-CoV-2 through aerosol microdroplets or contaminated surfaces and objects, such as food and packaging. Cold atmospheric pressure plasmas can represent a promising solution thanks to their ability in producing a blend of many reactive species which can inactivate the airborne aerosolized microorganisms or decontaminate surfaces. In this work, different plasma assisted solutions for the inactivation of SARS-CoV-2 will be shown. More specifically, a dielectric barrier discharge device is used to directly inactivate suitably produced bioaerosols containing purified SARS-CoV-2 RNA and SARS-CoV-2 virus flowing through it [1]. Results show that for low residence times in the plasma region, both microorganisms can be inactivated, and degradation of viral RNA can be achieved. Moreover, a preliminary study to test the effectiveness of a newly developed plasma sanitation system as strategy to decontaminate food packages from SARS-CoV-2 will be presented [2].

The results, taken together, highlight how CAP system could be used for the containment of SARS-CoV-2 diffusion through bioaerosol and fomite routes.

Acknowledgement

This work is funded by the 2014-2020 Emilia-Romagna Regional Operational Program of the European Regional Development Fund on industrial research and innovation projects for contrast solutions to the spread of COVID-19 - Project VIKI (VIrus KIller) - Plasma inactivation device to contrast bioaerosol indoor transport and Project PLASMA-DECON-FOOD: Cold atmospheric pressure plasma treatments for the decontamination of food and packaging infected by SARS-CoV-2.

References

[1] A. Bisag et al., Plasma Processes and Polymers, (2020) //doi.org/10.1002/ppap.202000154
[2] F. Capelli et. al., Appl. Sci., 11(9), 4177 (2021); doi.org/10.3390/app11094177