How can we exploit biomaterials for the benefit of plasma medicine?

Cristina Canal[1,2,3*]

[1] Biomaterials, Biomechanics and Tissue Engineering Group, Department of Materials Science and Engineering, Universitat Politècnica de Catalunya (UPC), Av. Eduard Maristany 14, 08019 Barcelona, Spain; * cristina.canal@upc.edu
[2] Barcelona Research Center in Multiscale Science and Engineering, UPC, Barcelona, Spain
[3] Research Centre for Biomedical Engineering (CREB), UPC, Barcelona, Spain

Short Bio

Cristina Canal is Associate professor at the Department of Materials Science and Engineering, at the Technical University of Catalonia (UPC), within the Biomaterials, Biomechanics and Tissue Engineering Group. She serves as vicedirector of the Center for Research in Biomedical Engineering (CREB).
Before joining UPC she did different research stages at pre and postdoctoral level in different national and international research centres. She has participated and lead a number of research projects, as well as technology transfer projects in the areas of Textile materials, Biomaterials and Cold Plasmas. Her research has led to above 60 publications, and several invited conferences. Her research has been recognized with different awards, including the L'Oreal-Unesco fellowship "For Young Women in Science" (2012) and the "2018 Early Career Award in Plasma Medicine".
Her interests are focused in cold plasmas for biomedical applications, particularly: i. Surface modification of biomaterials to control parameters such as adhesion or biological behaviour; ii. Control of drug release from biomaterials; and iii. Therapeutical appications of cold plasmas, for instance, in bone cancers.
She is currently leader of a European Research Council Starting Grant project in the field of Plasma Medicine, her main axis of research being currently focused in the atmospheric pressure plasma therapy of bone cancer treatment in combination with biomaterials.

Abstract

Biomaterials are employed for tissue and organs regeneration or functional repair, including delivery of therapeutics. In bone regeneration and repair, incorporation of drugs to biomaterials has been investigated as a means of providing additional functionalities to the material, and plasma processes contributed to bone biomaterials ie. through polymerisation processes to modulate the drug release[1].

With the evolution of plasma devices, great advances have been made in therapies based in cold atmospheric plasmas (CAP)[2,3]. CAP generate reactive oxygen and nitrogen species (RONS) which can be transferred to liquids and have shown to have selective anticancer effects towards osteosarcoma. Osteosarcoma (OS) is the most common primary bone cancer, presenting poor prognosis and difficult treatment. We have recently shown that CAP-treated Ringer's saline produced cytotoxic effects in human OS cell lines, while sustained viability was observed in healthy cells. Higher levels of DNA damage were found in OS cells leading to apoptotic cell death. This was confirmed in mouse OS tumour sections in organotypic culture[4].

However, injection of a liquid in the body results in fast diffusion due to extracellular fluids and blood flow. Therefore, the development of efficient vehicles which allow local confinement and delivery of RONS to the diseased site is a fundamental requirement. In this sense, biocompatible polymers with ability to form 3D networks can be an alternative to deliver the plasma-generated RONS locally. We will discuss the generation of RONS (H_2O_2, NO_2^-, short-lived RONS) in different hydrogels[5], whether these modify the physic-chemical properties of the material[6], and the biological effects associated to them.

References

1.K. Khurana et al. *Eur. Polymer Journal* 107, 25 (2018); 2. D. Graves, *Plasma Process*, 11, 1120 (2014); 3. A. Dubuc et al. *Ther Adv Med Oncol* 10, 1 (2018); 4. M. Mateu-Sanz et al. *Cancers*, 12(1), 227 (2020);5. C. Labay et al., *Scientific Reports* 9, 16160 (2019); 6. I. Hamouda et al. *Polymer*, 192, 122308 (2020).

Acknowledgements

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 714793).