

NanoSIMS50 analyses of *Escherichia coli* exposed to 18O and 15N afterglows

D. Duday¹, F. Clément², C. Penny¹, E. Lecoq¹, J-N. Audinot¹, C. Walczak¹,
E. Lentzen¹, P. Choquet¹, H.-M. Cauchie¹, T. Belmonte³

¹ Centre de Recherche Public Gabriel Lippmann, SAM & EVA, Belvaux Luxembourg

² Pau University UPPA – IPREM UMR 5254 – LCABIE,
Plasmas & Applications, Pau France

³ Nancy University – Institut Jean Lamour UMR 7198 – Matériaux Métallurgie Nanosciences
Plasmas Surfaces, Nancy France

E-mail: duday@lippmann.lu

Biomedical applications of cold plasmas need a better understanding of plasma interaction with biological tissues or organisms. This knowledge can be acquired not only through plasma modeling and diagnostics but also through fine characterizations of plasma treated tissues or organisms. This work is presenting a new method of characterization based on nano secondary ion mass spectrometry allowing the detection and imaging of isotopic atoms present on or in the microorganisms [1].

Isotopic R18OS and R15NS are produced in a microwave discharge at reduced pressure by using isotopic process gases and are transported in an uncharged region by the gas flow, in the so-called afterglows. These isotopic reactive species are then interacting with living bacteria. More precisely, this study deals with the production of oxygen, nitrogen and NO_x afterglows by using mixtures of Ar, 18O₂ and/or 15N₂. *Escherichia coli* bacteria have been exposed to these reactive media by varying several parameters like gas composition and duration of treatment. NanoSIMS analyses of the treated samples are realized to clarify the way oxygen, nitrogen and NO_x species act on bacteria.

The results show that it is possible to detect and localize isotopic atoms (18O, 15N) coming from the plasma in the plasma treated bacteria. Reactive species can pass through membranes and interact with bacteria cytoplasm. A saturation of the isotopic atoms fixed on the bacteria structure is observed after a critical plasma treatment time of few minutes.

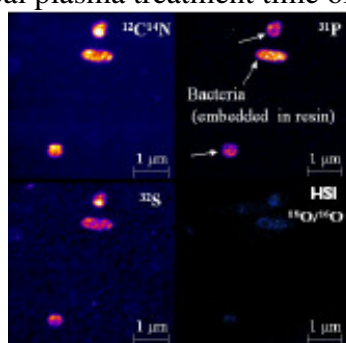


Figure 1: Cross-section cartography by NanoSIMS50 of 12C14N, 31P, 32S and HSI 18O/16O for *E. coli* exposed to Ar/18O₂ microwave afterglow during 15 min at 2mbars [2].

References

- [1] N. Musat, H. Halm, B. Winterholler, P. Hoppe, S. Peduzzi, F. Hillion, F. Horreard, R. Amann, B. B. Jørgensen, M. M. M. Kuypers, A single cell view on the ecophysiology of anaerobic phototrophic bacteria. PNAS, Nov. 18, 2008, vol. 105, no. 46.
- [2] F. Clément, E. Lecoq, D. Duday, T. Belmonte, J.N. Audinot, E. Lentzen, C. Penny, H.M. Cauchie, P. Choquet, NanoSIMS50 analyses of Ar/18O₂ plasma-treated *Escherichia coli* bacteria, New Journal of Physics 13 (2011) 113040.