

Atmospheric pressure plasma jet electro-optic diagnostics: the plasma-surface interface insights

A. V. NASTUTA^{1*}, R. HUZUM²

¹Physics and Biophysics Education Research Laboratory (P&B-EduResLab), Biomedical Science Department, Faculty of Medical Bioengineering, "Grigore T. Popa" University of Medicine and Pharmacy Iasi, Romania

²Integrated Center of Environmental Science Studies in the North Eastern Region (CERNESIM), Interdisciplinary Sciences Department, Interdisciplinary Research Institute (ICI-UAIC), "Alexandru Ioan Cuza" University of Iasi, Romania

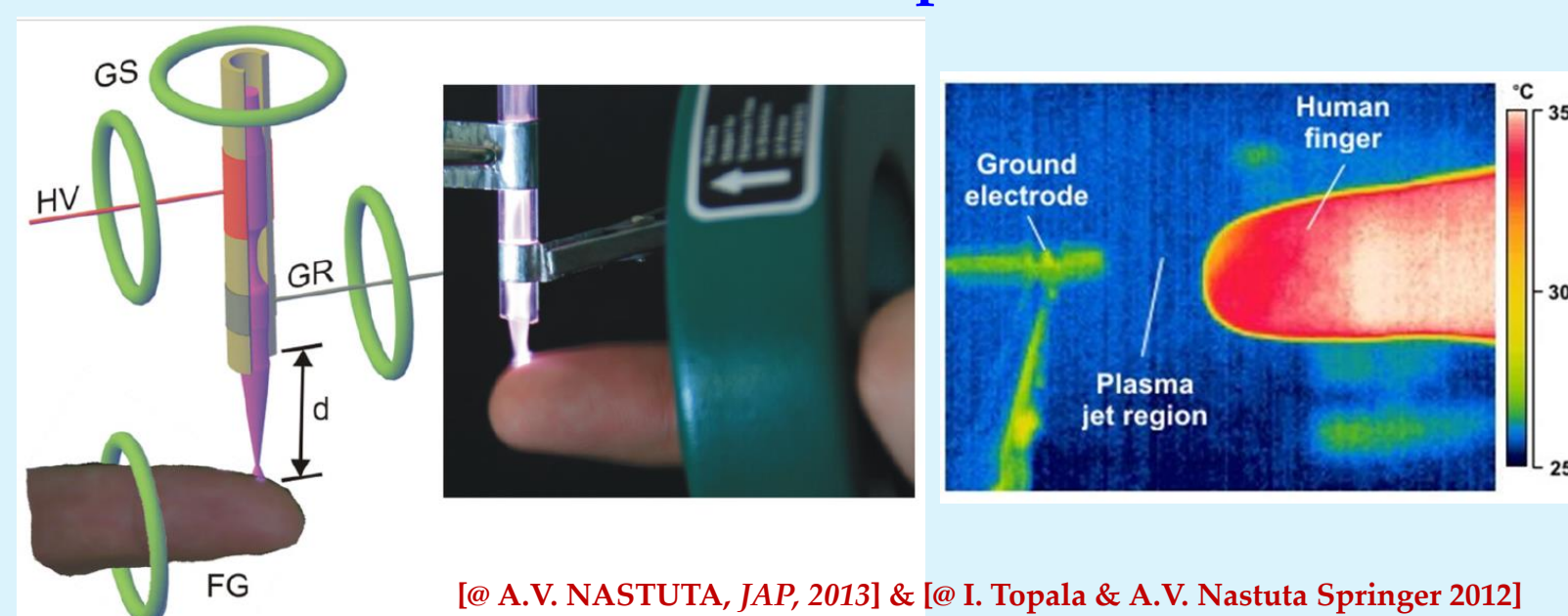
*andrei.nastuta@gmail.com

MOTIVATION

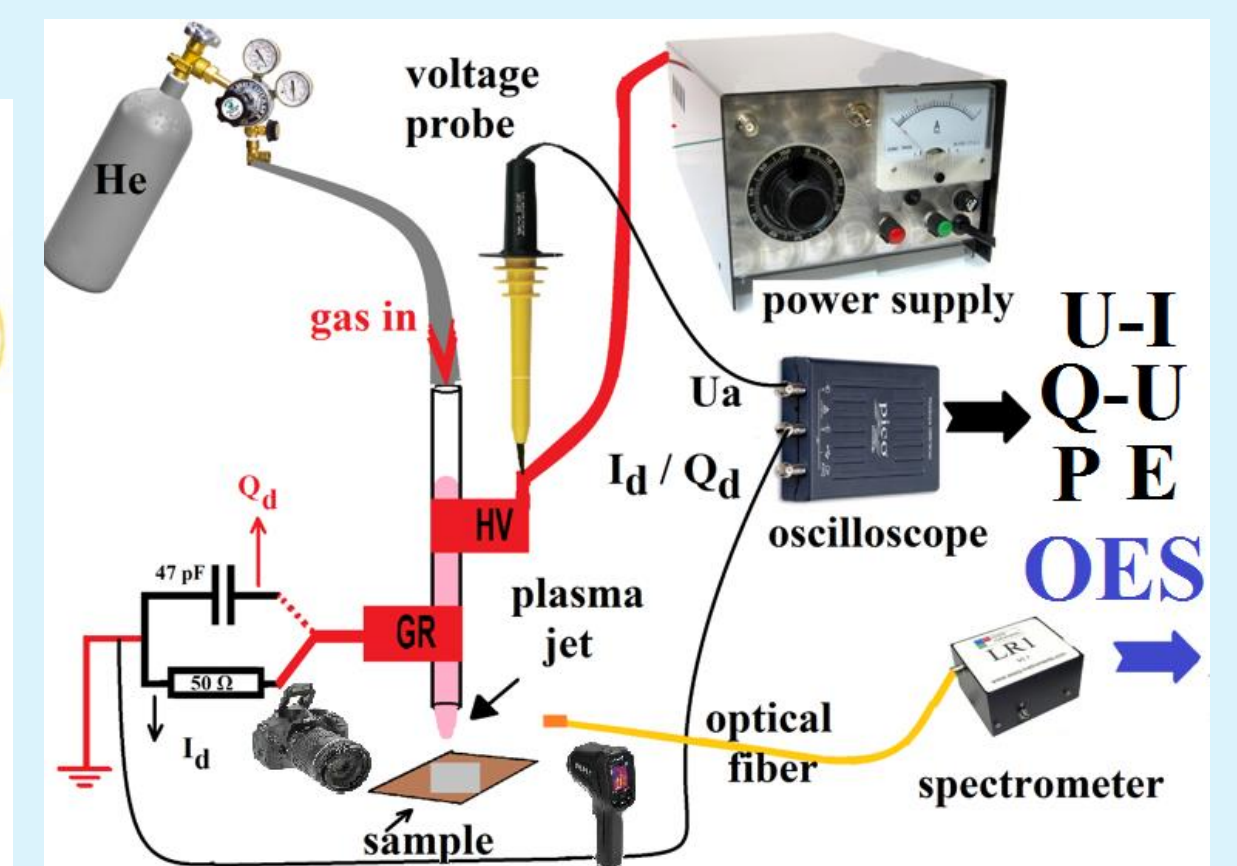
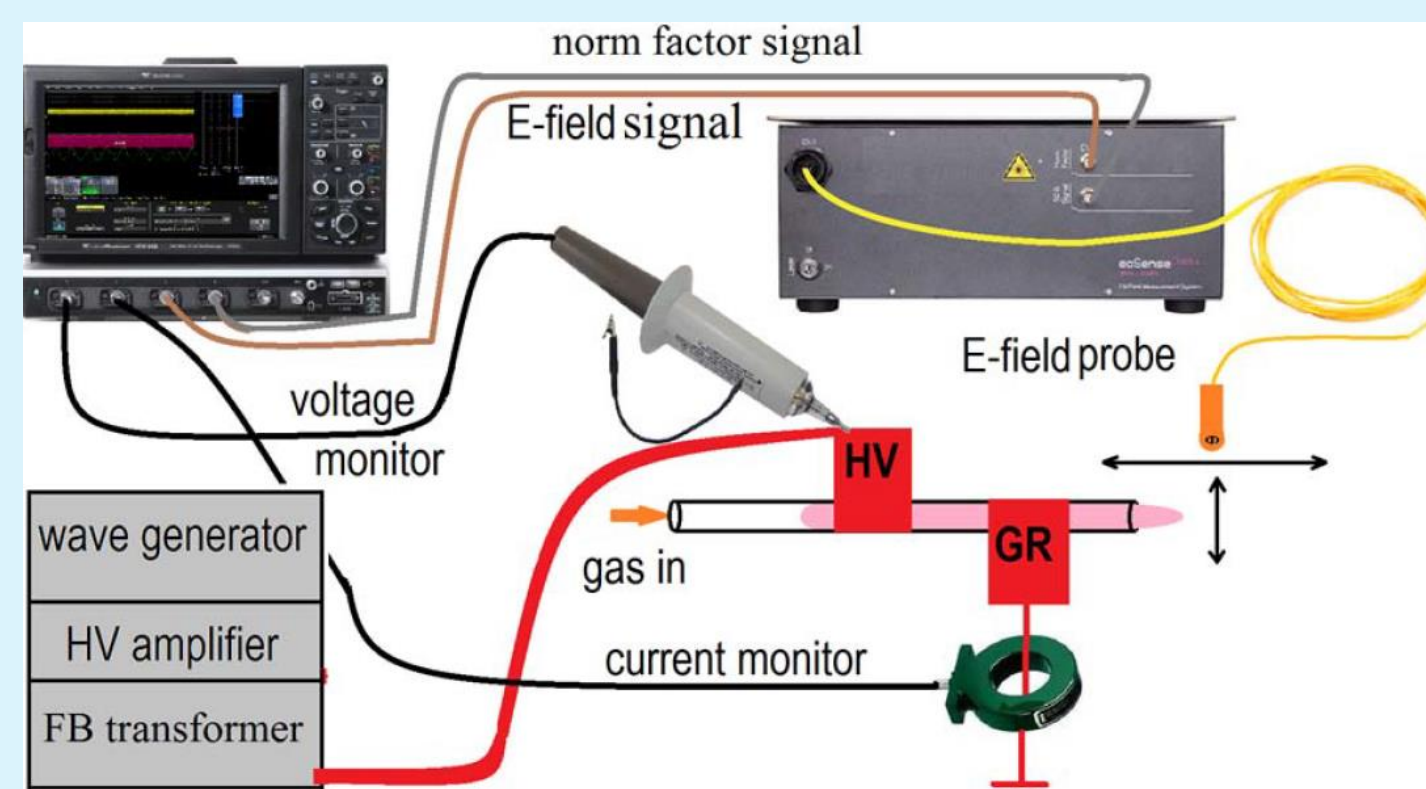
- Surfaces are important in many fields such as: medicine, textile industry, constructions and food industry; being important to know as many information as possible regarding the materials we study.
- Plasma seems to be a promising way to modify the surface and to control the morphology either by physical or chemical reactions like functionalization, crosslinking, etching or polymerization. By tailoring the plasma parameters, we may control some treatment effects on the surface.
- Along plasma source electrical diagnosis (U, I, Q, P, E, etc), the optical diagnosis (OES, fast photography, thermal imaging, etc), provides sensitive information for applying the electrical discharge onto material surface.

Materials & methods

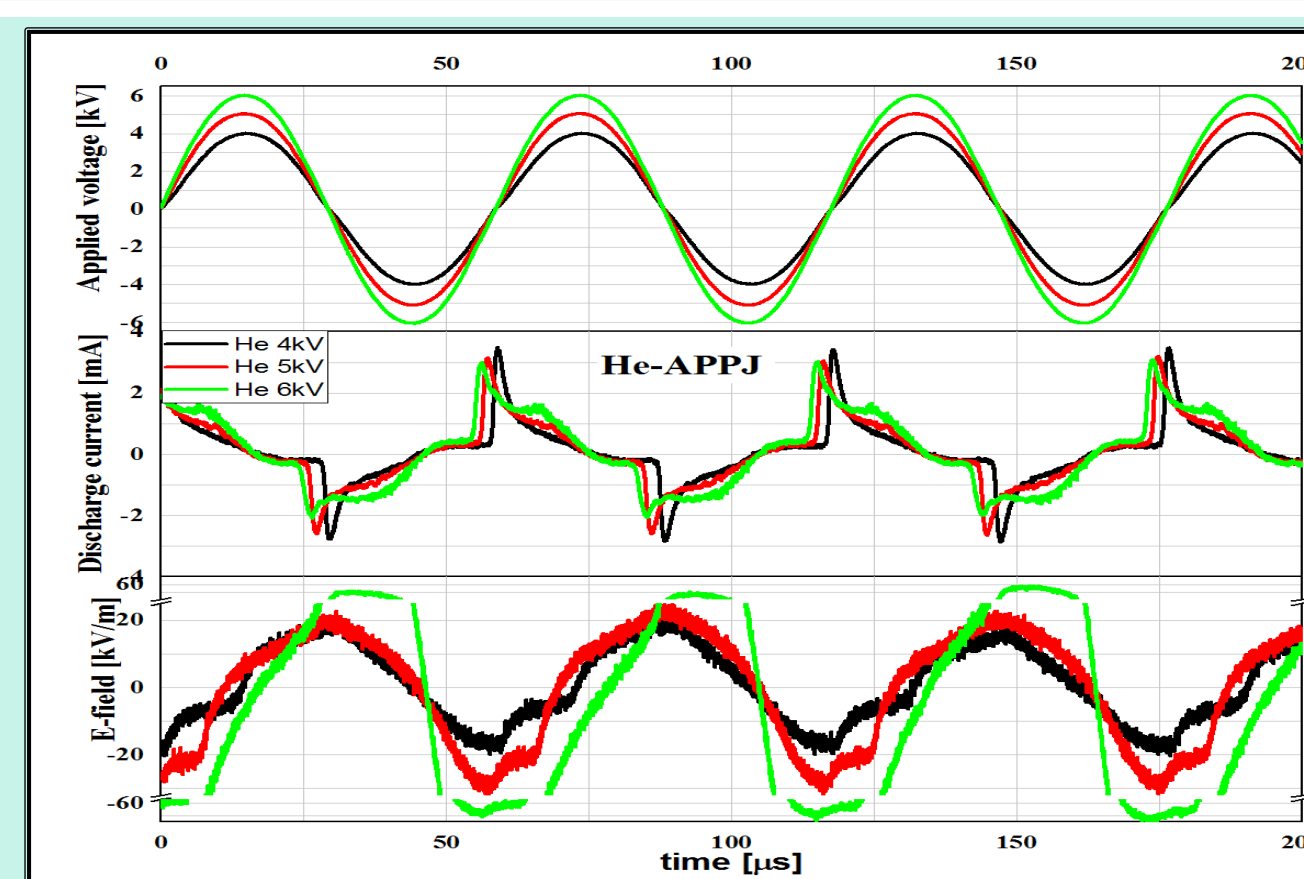
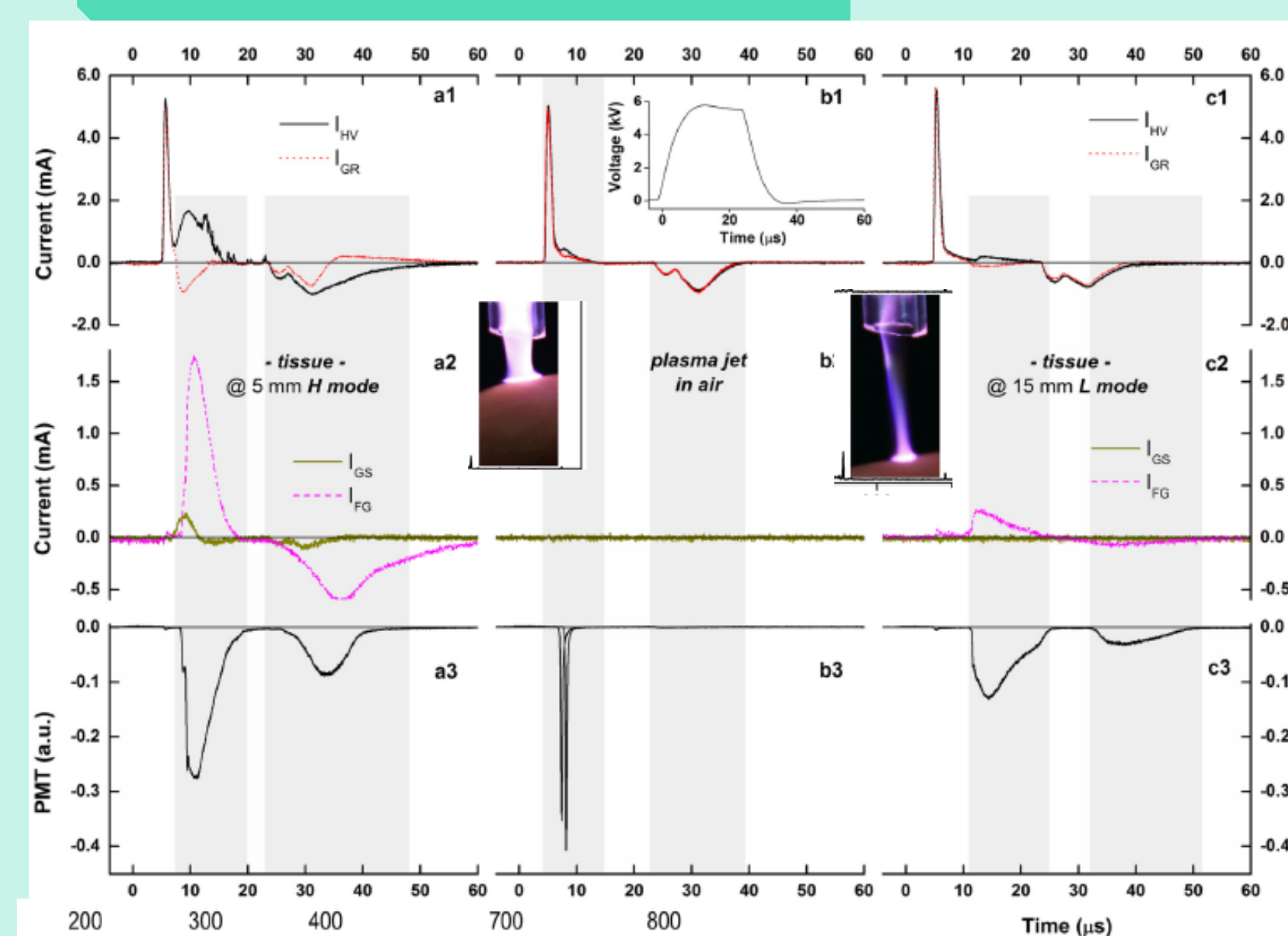
General set-up



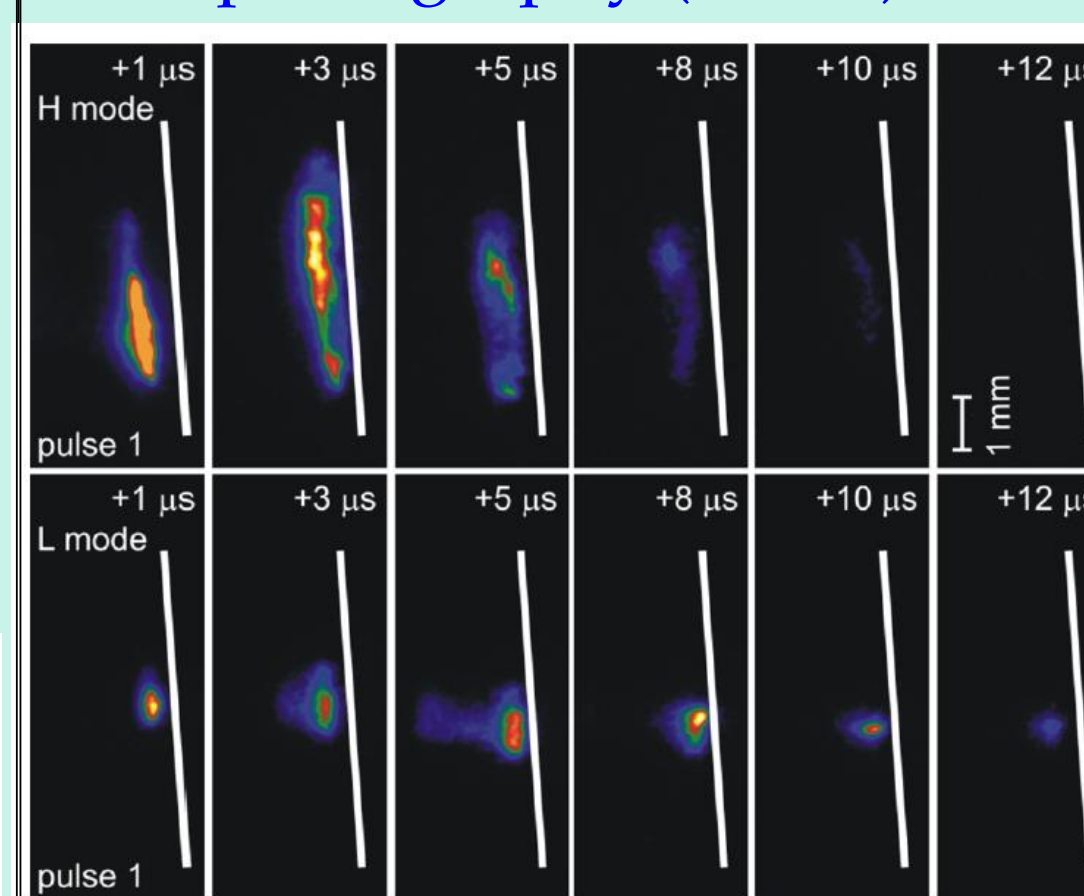
Electric field



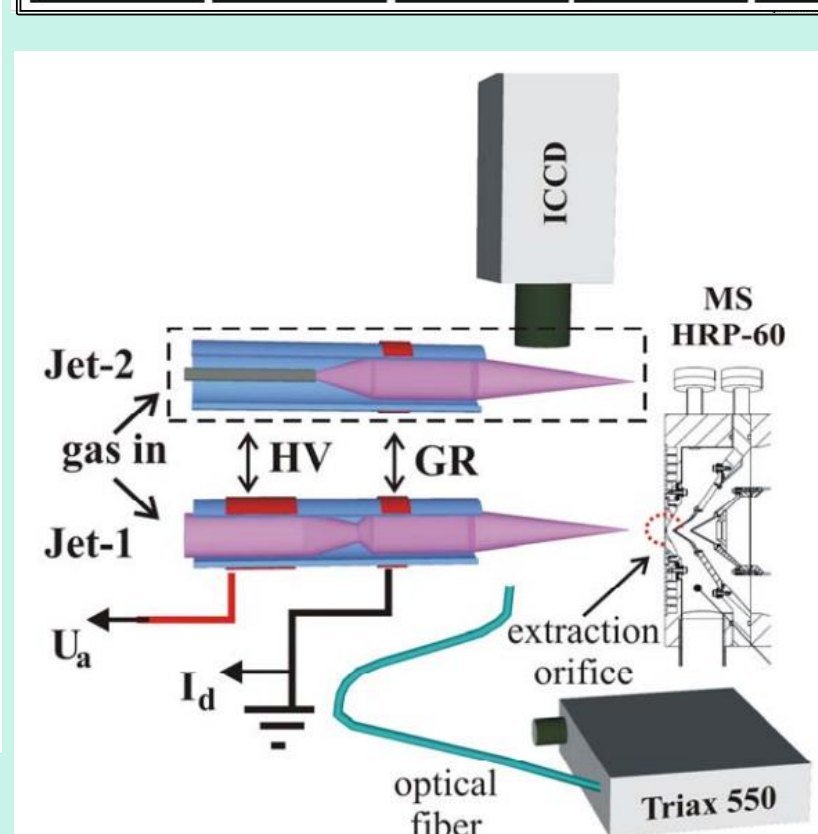
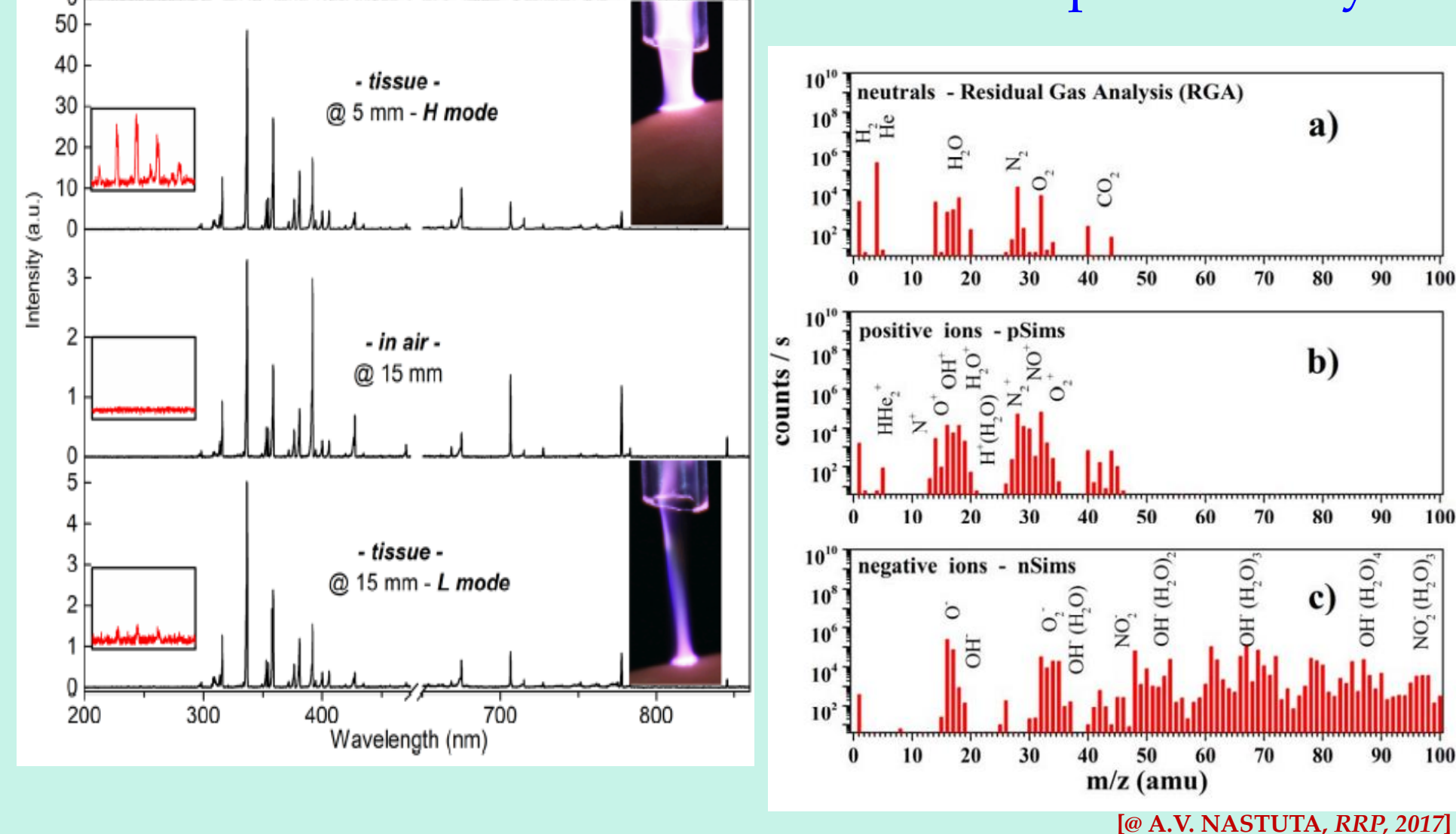
Results and Discussion



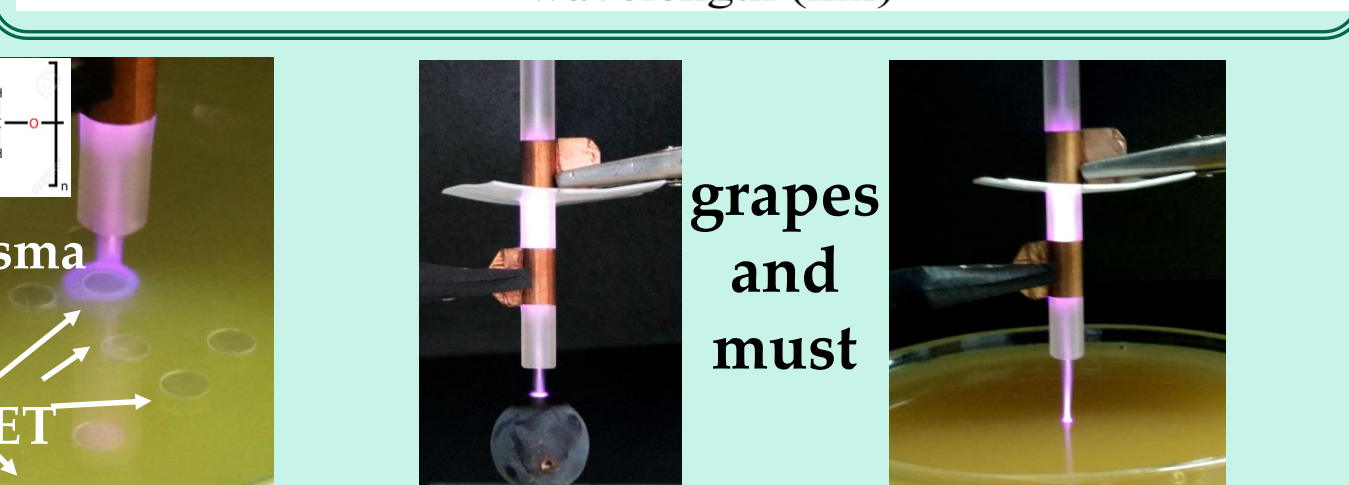
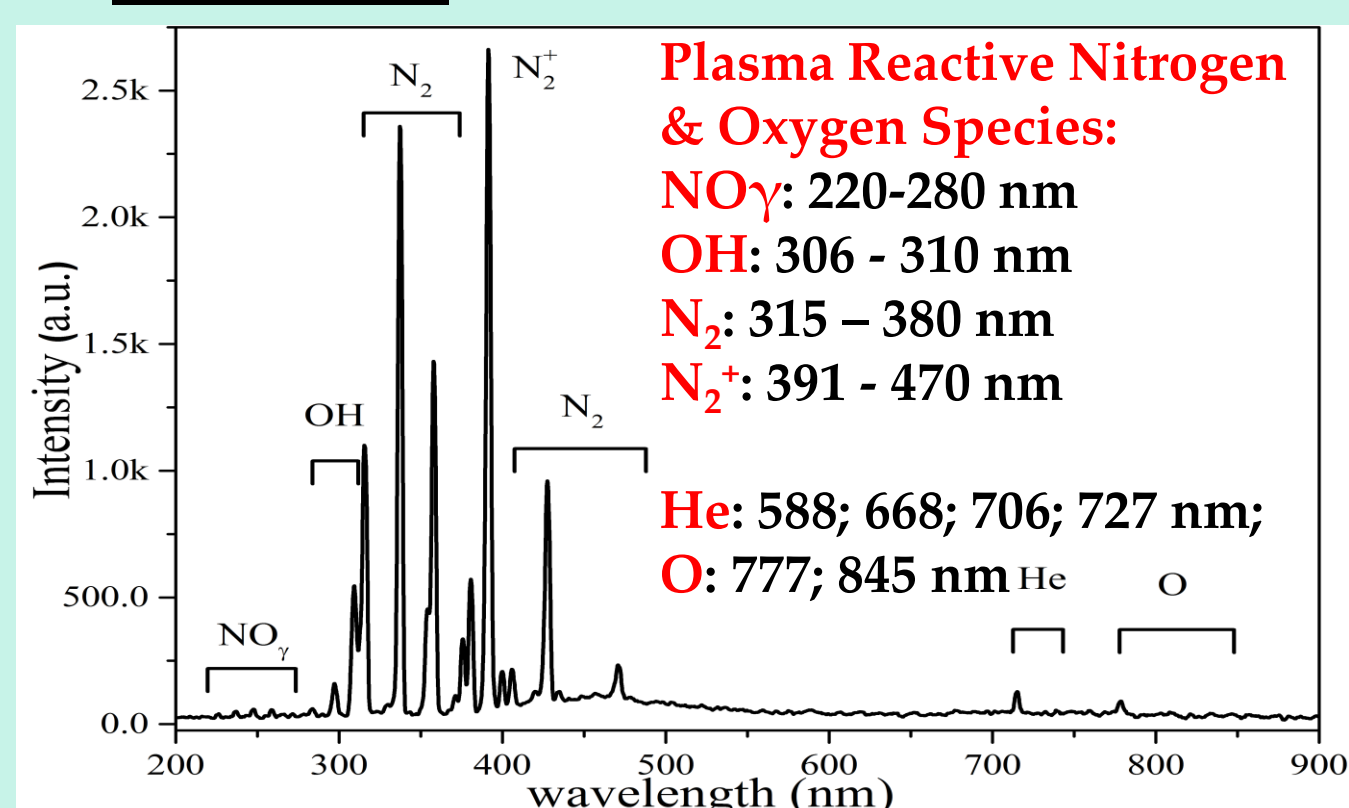
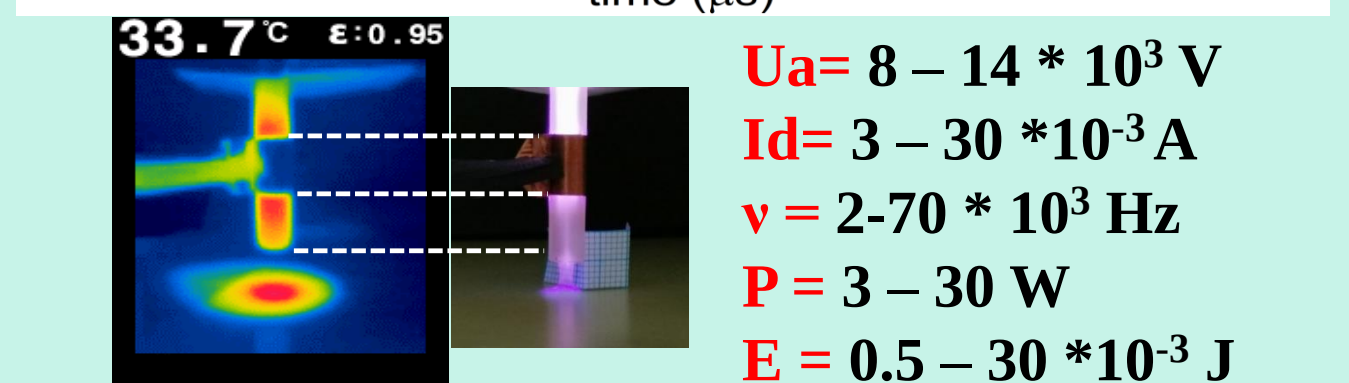
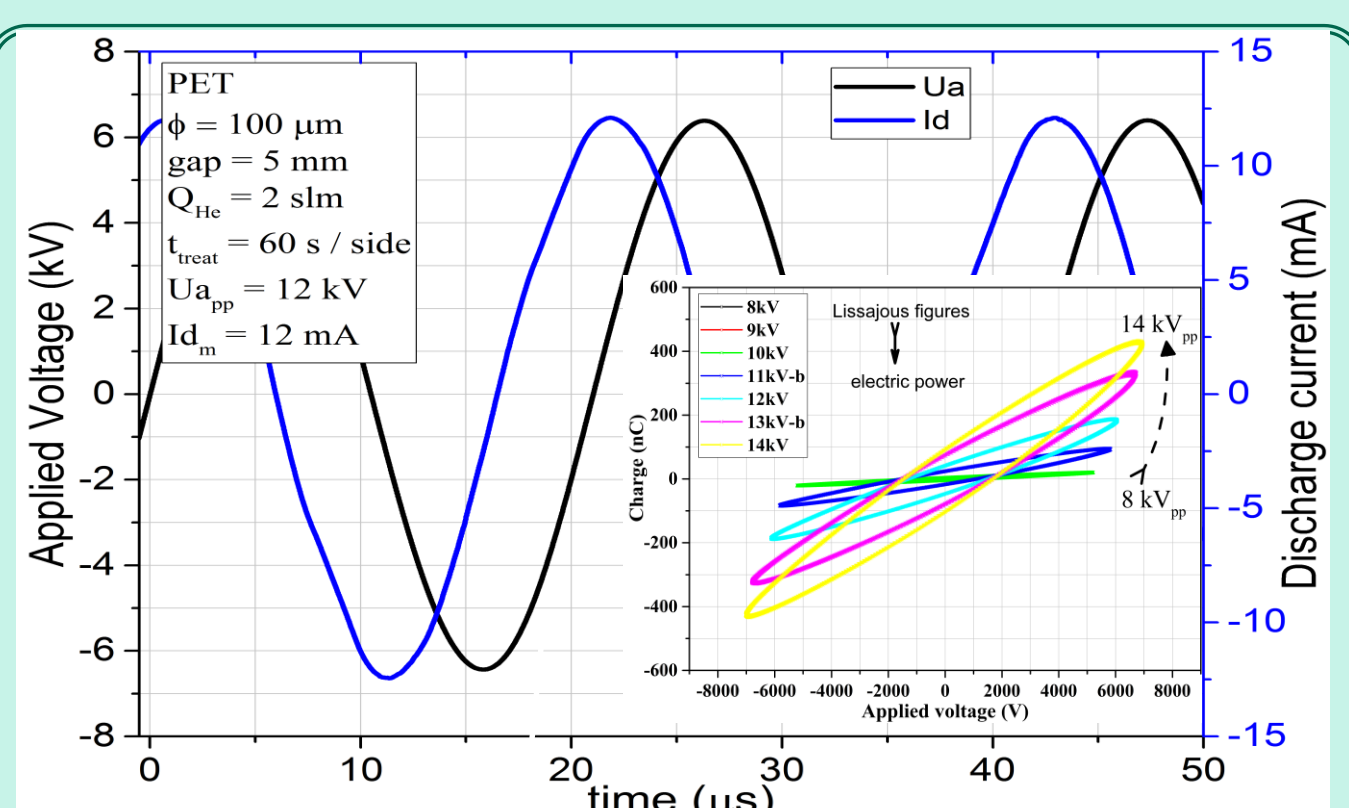
Plasma optical diagnosis fast photography (ICCD)



Plasma diagnosis Mass Spectrometry



He-Atmospheric Pressure Plasma Jet Electro-optical diagnosis



Conclusions

- The electrical and optical diagnosis of the studied plasma sources reveals the favorable operational parameters for proper surface treatment. Both the dissipated energies in the plasma and the presence of reactive O₂ and N₂ species in the plasma have a combined effect on the surface under treatment.
- Following studies on the morphology of surfaces, as a result of plasma treatments, the surfaces are much smoothed, with evenly distributed nanometric formations.
- New directions can be developed, in the sense of combining the technique of modification / functionalization with plasma of surfaces with chemical techniques (grafting, functionalization, polymerization).
- Nevertheless, furthermore experiment should be made in order to have a good control upon the surface modifications versus plasma treatment, including all plasma parameters that can have a significant role for a better wettability.

References

- A. V. Nastuta, et al., Surface modifications of polymer induced by atmospheric DBD plasma in different configurations, JOAM, 10(8):2038, (2008);
- A. V. Nastuta, et al., Stimulation of wound healing by helium atmospheric pressure plasma treatment, J. Phys. D: Appl. Phys., 44(10):105204, (2011);
- A. V. Nastuta, et al., Atmospheric pressure plasma jet—Living tissue interface: Electrical, optical, and spectral characterization, J. Appl. Phys., 113(18):183302 (2013);
- A. V. Nastuta, et al., Atmospheric pressure plasma jets in inert gases: electrical, optical and mass spectrometry diagnosis, Rom. Rep. Phys., 69(1):407 (2017);
- A. V. Nastuta, et al., Surface oxidation and enhanced hydrophilization of polyamide fiber surface after He/Ar atmospheric pressure plasma exposure, Rom. Rep. Phys., 71(4):413 (2019);

ACKNOWLEDGEMENT

This work was supported by 'Grigore T. Popa' University of Medicine and Pharmacy Iasi under the project 'Young Researcher Internal Grant', no. 30339/28.12.2017.