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(I) Plasma jet as a source of carbon monoxide (CO) for biomedical applications

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Carbon monoxide (CO) has a bad reputation due to potential lethal consequences when inhaled at high concentrations in humans. However, at low doses CO exerts a broad spectrum of biological activities that results in a variety of beneficial actions including among others anti-inflammatory, vasodilatory, anti-apoptotic and anti-proliferative effects [1].
Plasma can generate CO from the dissociation of CO2; in this context, non-equilibrium plasma at atmospheric pressure is an attractive in situ CO source since it is able to create CO at low doses from CO2 [2]. Moreover, plasma can be used for biomedical applications and intense research is now being conducted on its potential therapeutic use for the treatment of pathologies such as cancer and skin wounds. Plasmas are very versatile as they possess the capacity to generate large amounts of reactive species combined with electric field, photons and charged particles. However, the combination of plasma and CO for biomedical applications remains to be fully explored.

This presentation will focus on the challenge to develop a plasma reactor to generate controlled quantities of CO that can be used for therapeutic purposes. The reactor is based on plasma jet configuration where the discharge is produced in a coaxial dielectric barrier discharge (DBD) reactor equipped with a quartz capillary tube [3]. Helium with small addition of CO2 goes through the device. To assess and quantify the production of CO from plasma, we developed a system whereby mouse blood hemoglobin, a strong scavenger of CO, interact with the plasma reaction. Once CO binds to hemoglobin, it forms carboxyhemoglobin (COHb), which can be easily and precisely quantified by a spectrophotometer. We will present the first results showing that indirect and direct plasma treatments have different effects on the production of CO and its binding to hemoglobin.

[1] R. Motterlini and L. E. Otterbein, Nat. Rev. Drug Discov., vol. 9, no. 9, pp. 728–743, Sep. 2010.
[2] E. Carbone and C. Douat, Plasma Med., vol. 8, no. 1, pp. 93–120, 2018.
[3] T. Darny, J.-M. Pouvesle, V. Puech, C. Douat, S. Dozias, and E. Robert, Plasma Sources Sci. Technol., vol. 26, no. 4, p. 045008, Mar. 2017.

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