Direct impact and delayed post-discharge chemical reactions of Fe$^{II}$ complexes induced by non-thermal plasma

Samuel Laminski$^a$, Elie Acayanka$^a$, Serge Nzali$^a$, Peter Teke Ndifon$^a$, Jean-Louis Brisset$^b$*$

$^a$Inorganic Chemistry Department, University of Yaounde-I, P.O. Box 812, Yaounde, Cameroon
$^b$Laboratoire d’Electrochimie (L.E.I.C.A.), UFR des Sciences de l’Université de Rouen, 76821 Mont-St. Aignan, France

Email: brissjl@club-internet.fr

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ABSTRACT

Dilute solutions of organometallic complexes, i.e., Ferrocene and tris(1,10-phenanthroline)Fe$^{II}$ or ferroïn, readily oxidize when exposed to the gaseous species generated in a gliding electric discharge in humid air. Ferrocene (or bis-cyclopentadienyl Fe$^{II}$) turns to blue ferricinium ion while ferroïn solutions fade. Ferroïn is gradually oxidized to ferriïn which agrees with the higher sensitivity of the central metal to the action of plasma than the organic ligand engaged in the complex. The oxidation hardly obeys a pseudo 1st order kinetics law ($k_1^*=4\times10^{-2}$ min$^{-1}$). Additionally the oxidation reaction keeps on developing in post-discharge conditions according to a pseudo 1st order reaction ($k_1=5\times10^{-3}$ min$^{-1}$). This feature tends to generalize the occurrence of temporal post-discharge reactions which are of major interest for industrial applications.

Keywords: Gliding discharge; Non-thermal plasma; tris(1,10-phenanthroline),Fe$^{II}$; Ferrocene; Post-discharge; Humid air; Oxidation

*Corresponding author.