Numerical Simulation of Reactive Species in Liquids in Contact with Atmospheric Pressure Plasmas

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Generation of chemically reactive species that may affect biochemical reactions in liquid have been studied with the use of numerical simulations for a global chemical reaction model. When a living tissue is exposed to a low-temperature atmospheric-pressure plasma, there is almost always a liquid layer, such as blood or other body fluids, that separates the gas phase and the tissue. Therefore chemically reactive species generated by a plasma discharge in the gas phase need to be transported through the liquid phase before reacting with the tissue surfaces. During this transport process, some of the chemically reactive species may react with other species and, therefore, the observation of gas-phase chemically reactive species does not directly convey information on abundant chemically reactive species in the vicinity of the tissue. In the present study, we have performed numerical simulation of reaction equations that govern time evolution of the densities of various species in pure water under the global-balance (i.e., zero-dimensional) conditions. The liquid phase is assumed to be in contact with the gas phase and the density of each species between the gas and liquid phases are connected via Henry's law. Figure 1 shows time evolution of various species dissolved in water if the initial densities of NO and electrons are 10^{-10} mol/L each.

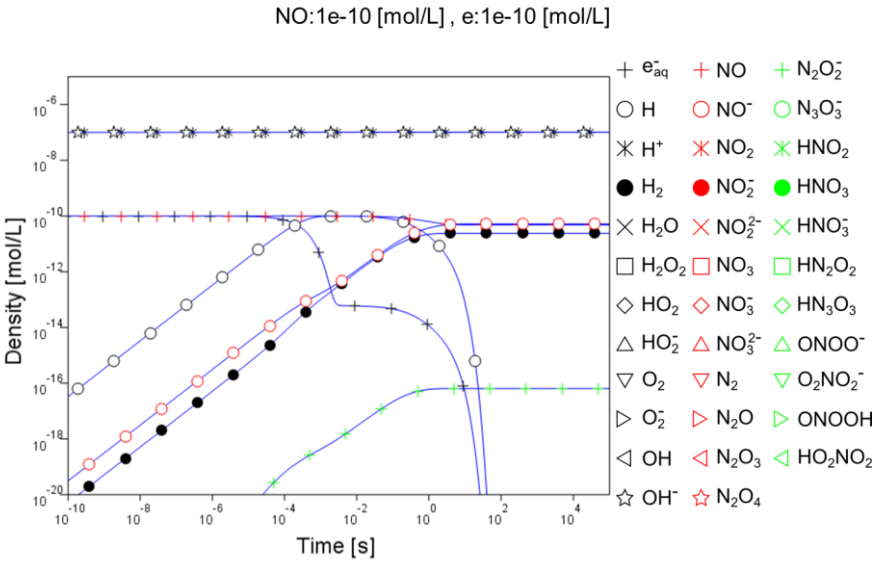

Figure 1: *Time evolution of densities of various species in pure water when NO of 10^{-10}mol/L and electrons of 10^{-10}mol/L are added at t = 0, obtained from global simulation.*