Characteristics of reactive oxygen and nitrogen species during nonthermal bioplasma interactions with biological cells immersed in fluids and its influences on the biomolecular surface electron energy structure

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We have investigated the characteristics of reactive oxygen species of OH and $O2^{*-}$ as well as reactive nitrogen species of NO by using the ultravilioet absorption spectroscopy in the atmospheric pressure nonthermal argon bioplasma sources interacting with the biological cells immersed in the fluids like water. It is noted in this study that these radical species play a very important role in the interactions between the bioplasma and biological cells, where their densities are found to be 3.7×10^{15} cm^{-3}, 1.3×10^{15} cm^{-3}, and 3.2×10^{14} cm^{-3}, respectively, for the OH, $O2^{*-}$, and NO radical species, respectively, under argon gas flow rate of 200 sccm. The secondary electron emission coefficient (γ) induced by a Auger neutralization of slow He ion beam, has been increased by nontherma plasma exposures, which might be caused by a damage on cell surface. It is also found that the molecular electron energy band structure for the bioplasma-treated cells has been shifted toward the vacuum surface energy since the biological surface cells might be oxidized by these reactive oxygen species.