COMPARISON OF THE ACTION MECHANISMS FOR COLD PLASMA OF ELECTRIC DISCHARGE AND RADIATION FOR HOT PLASMA OF PULSE DISCHARGE ON [[1]](#footnote-1)\*)AQUEOUS SOLUTIONS

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The cold plasma of the electric discharge can be in direct contact with the aqueous solution to be treated. Active species are generated in the discharge itself and enter the solution through the gas-liquid interface. The hot plasma of an electric pulse discharge on contact with the object will damage it. Therefore, devices operating with hot plasma can only act remotely on the object without thermal damage.

In the case of the hot plasma, the active factors of an electric pulse discharge remote from the object are species (radicals) formed in the discharge itself, which diffusing from the discharge region to the object, and light radiation of discharge. Under the action of light radiation, active species are formed in an aqueous solution. The action of light radiation penetrating into the solution is fundamentally different from the action of cold plasma which is in contact with the solution in that the cold plasma already contains all active species, while the radiation does not contain any active species. Species are formed in an aqueous solution when radiation passes. Let's consider the active factors of pulsed radiation in more details.

In the cold plasma of an electric discharge in air and in the presence of water vapor, all reactive oxygen species (ROS) and reactive nitrogen species (RNS) are generated. Hydroxyl radicals are most active. But due to the high reactivity, hydroxyl radicals are likely to terminate at the place of their formation, or are consumed at the first contact with substances dissolved in water and located on the surface. All other active species of cold plasma are absorbed through the gas-water interface and can diffuse into the depth of the solution.

For hot plasma, the main product formed in electric discharge, according to the Zeldovich mechanism, are NO• radicals. They diffuse to the surface of the aqueous solution and are absorbed in it. Absorbed radicals in water transform to nitrous acid. Under the action of pulsed radiation with wavelengths of 200 – 250 nm in water containing dissolved nitrogen and oxygen (air), HO2•/O2•−, O• radicals and molecules N2O are formed. Radiation passes into water to a considerable depth. Attenuation of radiation with a wavelength of 200 nm in a 10 cm distilled water layer is 30%. Further interactions of these primary species lead to the formation of nitrous acid (as well as when NO• radicals are absorbed from the gas phase) and a complex (…ONOOH/ONOO−…), which decomposes into peroxynitrite and peroxynitrous acid in up to 14 days. Primary and secondary products determine the reactivity of water.

The radiation yields of oxidation and reduction under the action of pulsed radiation of hot plasma are ~ 6 (100 eV)−1, the radiation yield of nitrous acid does exceed 0.5 (100 eV)−1. Hence it follows that main active agents are the decomposition products of the complex. The experiments carried out by the authors confirm the described mechanism of the action of pulsed radiation of hot plasma on aqueous solutions.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Pt/ru/GQ-Piskarev.docx) [↑](#footnote-ref-1)