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Modeling of Processes Running in Radical Clusters Formed by Ionizing Radiation with the Help of Continuous Petri Nets and Oxygen Effect

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Abstract : The final biological effect of ionizing particles may be influenced strongly by some chemical substances present in cells mainly in the case of low-LET radiation. The influence of oxygen may be particularly important because oxygen is always present in living cells. The corresponding processes are then running mainly in the chemical stage of radio biological mechanism. The radical clusters formed by densely ionizing ends of primary or secondary charged particles are mainly responsible for final biological effect. The damage effect depends then on radical concentration at a time when the cluster meets a DNA molecule. It may be strongly influenced by oxygen present in a cell as oxygen may act in different directions: at small concentration of it the interaction with hydrogen radicals prevails while at higher concentrations additional efficient oxygen radicals may be formed. The basic radical concentration in individual clusters diminishes, which is influenced by two parallel processes: chemical reactions and diffusion of corresponding clusters. The given simultaneous evolution may be modeled and analyzed well with the help of Continuous Petri nets. The influence of other substances present in cells during irradiation may be studied, too. Some results concerning the impact of oxygen content will be presented.

Keywords : radiobiological mechanism, chemical phase, DSB formation, Petri nets
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