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Radiofrequency radiation effects in biomedical applications

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We review our recently obtained data on developing the model of the interaction of spherical colloidal nanoparticles with low-frequency electromagnetic waves. The aim was to describe quantitatively the interaction of NP-electrolyte system with low-frequency electromagnetic waves for medical applications. We consider the RF heating of a nanoparticle immersed into the electrolyte solutions of varied conductivity. The proposed model allowed us to successfully describe the previously observed effect of strong heating of aqueous suspension of Si and Au NPs under RF irradiation with frequencies varied from 0.1 MHz to 500 MHz. We focused only on the description of heating in MHz region and did not take into account the dielectric losses in water. Our phenomenological analysis shows that presence of NPs can significantly affect the RF heating, especially at low electrolyte conductivities. The model explains the heating dependence on frequency of electromagnetic waves. We also found that optimum particle conductivity for maximum heating is located in range 0.1-1 Sm/m at 30 MHz and -50 mV zeta-potential, while the NP size shows quite insignificant impact on the heating. It should be noted that the observed weak dependence of the RF radiation-induced heating efficiency on conductivity of employed nanoparticle-based sensitizers is a pleasant surprise, which can opens up novel avenues for the development of mild cancer treatment modalities based on the employment of RF radiation.

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