Effect of ionizing radiation on dextran-coated iron oxide nanoparticles

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Nanostructured materials such as nanoparticles (NPs), nanowires, and quase-2D materials have received great attention as advanced systems for the emerging nanomedicines [1]. In medical applications, such as in radiotherapy treatment, NPs may be exposed to ionizing radiation. The preservation of the physical-chemical properties of the nanostructures when subjected to radiation is highly desirable [2]. Thus possible changes in their structure and properties due to radiation exposure need to be carefully investigated. In this work, we report on the effect of 6 MV X-ray beam from a clinical radiotherapy accelerator on the structure and properties of dextran-coated iron oxide NPs. The samples used consisted of NPs synthesized by the polyol route suspended in deionized water at different concentrations (0.02 and 0.01 g/L). The irradiations were performed in a Clinac IX (Varian) machine, using doses between 10 and 300 Gy. For all doses tested, TEM and DLS data detected no significant changes in the morphology or size of the NPs. Zeta Potential were also stable for all applied doses. Nuclear magnetic relaxation of the NPs dispersions, however, changed at high doses. The transverse relaxation time (T2) increase with increasing dose, changing from 121.7 ± 13.2 ms for the pristine NPs to 194.7 ± 7.5 ms after 300 Gy in the 0.02 g/L dispersions. A similar trend was observed for the T2 of the 0.01 g/L dispersions (135.1 ± 13.9 ms for the unirradiated sample and 202.5 ± 27.7 ms after 300 Gy). Although it has not been possible to establish a clear quantitative relationship between dose and the effect on the properties of NPs, the modifications seen only occur at doses much higher than those involved in clinical use.

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References:

[1] S. Laurent, et al., American Chemical Society: v. 108, p. 2064-2110 (2008)

[2] D.Winkel, et al., Clinical and Translational Radiation Oncology: v. 18, p.54-59 (2019)