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Abstract

Superparamagnetic Iron Oxide Nanozymes for Synergistic Cancer Treatment †

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Despite the great advances in cancer treatment options, cancer incidence and associated mortality continue to be major health concerns worldwide. Conventional therapies such as surgery, radio-, and chemotherapy, although effective in most cases, are usually associated with partial, brief, and unpredictable tumor response. Thus, there is an urge to improve the quality and specificity of treatments. The development of new cancer treatment options aims to decrease the delay between treatments, consequently improving patient care by personalizing cancer approaches. Therefore, one of the most common platforms used is superparamagnetic oxide nanoparticles (SPIONs). The iron oxide core can act as a heat source, being used in magnetic hyperthermia due to the increase in its bulk temperature and the surroundings when an alternating magnetic field is applied [1,2]. Along with the known properties of SPIONs, these nanoparticles can mimic enzymatic activities, such as those of peroxidase and of catalase. The latter converts hydrogen peroxide to water and oxygen, helping overcome the hypoxia present in tumor tissues. Another way to boost catalase activity and consequently improve hyperthermia outcomes is to functionalize SPIONs with the enzyme catalase to overcome hypoxia in situ.

The SPION surface was modified and extensively characterized [3,4]. The enzyme-like activity of peroxidase and catalase of coated nanoparticles was also evaluated. After this characterization, catalase was immobilized onto the nanoparticle surface. The immobilization complexes were submitted to magnetic hyperthermia, and the temperature variations showed it to be possible to achieve the hyperthermic temperature of 42 °C. Finally, the complexes' cytotoxicity was assessed using both a non-tumoral and a tumoral cell line. The results demonstrated that the SPIONs developed are promising agents for cancer treatment through a combination of enzymatic activity and magnetic hyperthermia.

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