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Near-infrared light-responsive magnetic nanoparticles - preparation and application in photothermal therapy

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One of the non-invasive techniques used in the fight against cancer is conventional hyperthermia, which, despite being very effective in destroying tumor cells, has low spatial selectivity and severely affects healthy tissues. Photothermal therapy (PTT), which uses near-infrared absorbing magnetic nanoparticles to generate heat from optical energy, is of great interest as the method is controllable, highly efficient, less invasive and poses much fewer side effects compared with standard approaches such as chemotherapy and radiotherapy. The combination of photothermal therapy with hyperthermia mediated by magnetic nanocomposites can also help in eliminating inflammatory macrophages and enhancing tumor-cell permeability and retention effect.

Over the last decade, scientists worldwide have focused on improving the PTT effects of magnetic nanoagents by optimizing synthesis and coating methods with appropriate near-infrared (NIR) -sensitive materials. In order to develop an effective PTT mediator, the carriers created must meet the following criteria: small size, photostability, facile synthesis, non-toxicity and dual modality. The magnetic materials irradiated under a NIR laser must make full usage of the resulting thermal energy to destroy cancer cells without affecting healthy tissues. An optimal combination of materials, synthesis methods, and coating approaches are presented in this study focusing on Fe_3O_4 magnetic nanoparticles. In addition, the possibilities for optimizing the effects of magnetic hyperthermia are considered.

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