Magnetic Nanorobots with Enzymatic Cascades for Active In Vivo Tumor Targeting and Chemodynamic Therapy

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Precision cargo delivery to malignant tissues is essential for enhancing drug efficacy while minimizing side effects in cancer therapy and diagnosis.[1] Nanorobots have gathered considerable attention for their potential use in targeted cargo delivery within complex biological environments.[2,3] Specifically, magnetic nanorobots (MNRs) offer remote, accurate, and minimally invasive maneuverability.[4,5] Despite these advancements, there is an ongoing need for the development of robust and biocompatible MNRs. In this study, we report the facile synthesis of a novel MNRs using the biocompatible building blocks, including Fe_3O_4 nanoparticles (NPs), ferrous ions (Fe^{2+}), and tannic acid (TA). By applying a magnetic field, the 30-nm Fe_3O_4 NPs undergo rapid linear alignment. Concurrently, the chelation of Fe^{2+} and TA creates networks linking the aligned particles, forming robust chain-like MNRs with length≈500 nm and width≈40 nm. These MNRs exhibit excellent peroxidase-mimicking activity. Furthermore, glucose oxidase (GOx), copper ions (Cu^{2+}), and human serum albumin (HSA) are co-loaded onto the MNRs' surface. The resulting multi-enzymatic MNRs@GOx/Cu/H demonstrates an anticancer effect by depleting glucose, self-supplying H_2O_2, generating ·OH, and depleting GSH. Importantly, magnetic guidance significantly improves the in vivo antitumor efficacy of MNRs@GOx/Cu/H by enhancing their specific accumulation at tumor sites. These prepared MNRs have great potential for targeted treatment of various diseases via accurate delivery of corresponding drugs to disease sites.

References:

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