Near-Infrared Light in Intelligent Nanoplatform for Synergistic Chemotherapy and Phototherapy of Cancer

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Cancer remains one of the most deadly diseases worldwide. Despite the encouraging progress in cancer therapy, an urgent need for new, more efficient cancer treatment methods still exists. Conventional treatments such as chemotherapy, radiotherapy, and surgery often are accompanied by many drawbacks, including side effects, severe pain, drug resistance, and weak effectiveness due to the instability and rapid clearance of drugs, resulting in unsatisfactory outcomes of anticancer therapy.

Drug delivery systems (DDSs) based on nanomaterials have shown great promise to overcome these limitations and improve cancer treatment efficacy. Nanomaterials due to their unique properties increase drug stability, reduce systemic toxicity, improve pharmacokinetics, elevate bioavailability, precise drug transportation capability, and control drug release. However, localizing the on-demand release of anticancer drugs in tumor tissues remains a great challenge. In this regard, photoresponsive DDSs that use light as an external stimulus can offer precise spatiotemporal control of drug release at desired sites. Most photoresponsive DDSs are only responsive to ultraviolet-visible light that shows phototoxicity and/or shallow tissue penetration depth, thereby greatly restricting their applications. Near-infrared (NIR) photoresponsive DDSs have been developed to address these issues. They can achieve on-demand drug release in tumors through photothermal, photodynamic, and photoconversion mechanisms, affording amplified therapeutic effects in synergy with phototherapy. Thus, the combination of near-infrared light, chemotherapy, and nanotechnology is a preposition for developing perspective and intelligent nanoplatforms for synergic cancer therapies.

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