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In Situ Nanoreactor for Photosynthesizing H_2 Gas To Mitigate Oxidative Stress in Tissue Inflammation

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Abstract

Hydrogen gas can reduce cytotoxic reactive oxygen species (ROS) that are produced in inflamed tissues. Inspired by natural photosynthesis, this work proposes a multicomponent nanoreactor (NR) that comprises chlorophyll a, l-ascorbic acid, and gold nanoparticles that are encapsulated in a liposomal (Lip) system that can produce H_2 gas in situ upon photon absorption to mitigate inflammatory responses. Unlike a bulk system that contains free reacting molecules, this Lip NR system provides an optimal reaction environment, facilitating rapid activation of the photosynthesis of H_2 gas, locally providing a high therapeutic concentration thereof. The photodriven NR system reduces the degrees of overproduction of ROS and pro-inflammatory cytokines both in vitro in RAW264.7 cells and in vivo in mice with paw inflammation that is induced by lipopolysaccharide (LPS). Histological examinations of tissue sections confirm the ability of the NR system to reduce LPS-induced inflammation. Experimental results indicate that the Lip NR system that can photosynthesize H_2 gas has great potential for mitigating oxidative stress in tissue inflammation.

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