Chemodynamic therapy

Fenton reaction-based chemodynamic therapy (CDT), which applies metal ions to convert less active hydrogen peroxide (H_2O_2) into more harmful hydroxyl peroxide (·OH) for tumor treatment, has attracted increasing interest recently. However, the CDT is substantially hindered by glutathione (GSH) scavenging effect on ·OH, low intracellular H_2O_2 level, and low reaction rate, resulting in unsatisfactory efficacy. Here, a cancer cell membrane (CM)-camouflaged Au nanorod core/mesoporous MnO_2 shell yolk-shell nanocatalyst embedded with glucose oxidase (GOD) and Dox (denoted as AMGDC) is constructed for synergistic triple-augmented CDT and chemotherapy of tumor under MRI/PAI guidance. Benefiting from the homologous adhesion and immune escaping property of the cancer CM, the nanocatalysts can target tumors and gradually accumulate in the tumor site. For triple-augmented CDT, first, the MnO_2 shell reacts with intratumoral GSH to generate Mn^{2+} and glutathione disulfide, which achieves Fenton-like ion delivery and weakening of GSH-mediated scavenging effect, leading to GSH depletion-enhanced CDT. Second, the intratumoral glucose can be oxidized to H_2O_2 and gluconic acid by GOD, achieving supplementary H_2O_2-enhanced CDT. Next, the AuNRs absorbing in NIR-II elevate the local tumor temperature upon NIR-II laser irradiation, achieving photothermal-enhanced CDT. Dox is rapidly released for adjuvant chemotherapy due to responsive degradation of MnO_2 shell. Moreover, GSH-activated PAI/MRI can be used to monitor CDT process. This study provides a great paradigm for enhancing CDT-mediated antitumor efficacy. [1)]

2: Liu D, Dai X, Ye L, Wang H, Qian H, Cheng H, Wang X. Nanotechnology meets glioblastoma multiforme: Emerging therapeutic strategies. Wiley Interdiscip Rev Nanomed Nanobiotechnol. 2022 Aug 12:e1838. doi: 10.1002/wnan.1838. Epub ahead of print. PMID: 35959642.

3: Han W, Wang M, He H, Jiang Y, Lu C, Tu X. A procedurally activatable nanoplatform for chemo/chemodynamic synergistic therapy. Biomater Sci. 2022 May 17;10(10):2673-2680. doi: 10.1039/d1bm01940f. PMID: 35437541.

4: Zhong X, Dai X, Wang Y, Wang H, Qian H, Wang X. Copper-based nanomaterials for cancer theranostics. Wiley Interdiscip Rev Nanomed Nanobiotechnol. 2022 Jul;14(4):e1797. doi: 10.1002/wnan.1797. Epub 2022 Apr 13. PMID: 35419993.

5: Mu M, Chen H, Fan R, Wang Y, Tang X, Mei L, Zhao N, Zou B, Tong A, Xu J, Han B, Guo G. A Tumor-Specific Ferric-Coordinated Epigallocatechin-3-gallate cascade nanoreactor for glioblastoma therapy. J Adv Res. 2021 Jul 30;34:29-41. doi: 10.1016/j.jare.2021.07.010. PMID: 35024179; PMCID: PMC8655135.

6: Guan S, Liu X, Fu Y, Li C, Wang J, Mei Q, Deng G, Zheng W, Wan Z, Lu J. A biodegradable “Nano-donut” for magnetic resonance imaging and enhanced chemo/photothermal/chemodynamic therapy through responsive catalysis in tumor microenvironment. J Colloid Interface Sci. 2022 Feb 15;608(Pt 1):344-354. doi: 10.1016/j.jcis.2021.09.186. Epub 2021 Sep 30. PMID: 34626980.

7: Ding B, Zheng P, Li D, Wang M, Jiang F, Wang Z, Ma P, Lin J. Tumor microenvironment-triggered in situ cancer vaccines inducing dual immunogenic cell death for elevated antitumor and antimetastatic therapy. Nanoscale. 2021 Jun 24;13(24):10906-10915. doi: 10.1039/d1nr02018h. PMID: 34128036.

8: Li X, Wang Z, Ma M, Chen Z, Tang XL, Wang Z. Self-Assembly Iron Oxide Nanoclusters for

Photothermal-Mediated Synergistic Chemo/Chemodynamic Therapy. J Immunol Res. 2021 Apr 7;2021:9958239. doi: 10.1155/2021/9958239. PMID: 33880384; PMCID: PMC8046545.

9: Sui C, Tan R, Chen Y, Yin G, Wang Z, Xu W, Li X. MOFs-Derived Fe-N Codoped Carbon Nanoparticles as O_2-Evolving Reactor and ROS Generator for CDT/PDT/PTT Synergistic Treatment of Tumors. Bioconjug Chem. 2021 Feb 17;32(2):318-327. doi: 10.1021/acs.bioconjchem.0c00694. Epub 2021 Feb 5. PMID: 33543921.

10: Tang XL, Wang Z, Zhu YY, Xiao H, Xiao Y, Cui S, Lin BL, Yang K, Liu HY. Hypoxia-activated ROS burst liposomes boosted by local mild hyperthermia for photo/chemodynamic therapy. J Control Release. 2020 Dec 10;328:100-111. doi: 10.1016/j.jconrel.2020.08.035. Epub 2020 Aug 26. PMID: 32858074.

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Pan Y, Zhu Y, Xu C, Pan C, Shi Y, Zou J, Li Y, Hu X, Zhou B, Zhao C, Gao Q, Zhang J, Wu A, Chen X, Li J. Biomimetic Yolk-Shell Nanocatalysts for Activatable Dual-Modal-Image-Guided Triple-Augmented Chemodynamic Therapy of Cancer. ACS Nano. 2022 Oct 31. doi: 10.1021/acsnano.2c08077. Epub ahead of print. PMID: 36315056.