Iron oxide and various metal oxide hollow nanoparticles engineered by one-pot double galvanic replacement reaction and the application for anti-cancer therapy.

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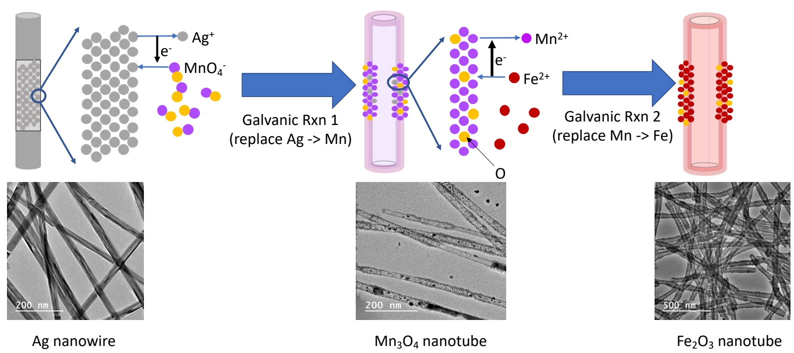
Abstract

Although freestanding hollow one-dimensional metal oxide nanoparticles represent an intriguing class of nanomaterials, their practical application has been hampered by complex and expensive synthesis protocols. Here, a new one-pot double Galvanic approach that is both simple and economical is developed for the synthesis of hollow one-dimensional iron oxide nanotubes.[1] In the initial reaction, nanowire substrate (Ag) is oxidized by MnO_4^- ions to form an intermediate nanotube substrate (Mn_3O_4), which is then reduced by Fe^{2+} ions to form an Fe_2O_3 nanotube product. Mn_3O_4 intermediate aid to expand the scope of the reaction for various metal oxides. To test the generality of this approach, the synthesis of SnO_2, CuO, and NiO_2 nanotubes is also examined. Thus, this method could offer robust, economical, and scale-up engineering to generate a variety of metal oxide nanotubes based on the reduction potential hierarchy. As proof-of-principle for the application of these hollow iron-oxide nanoparticles for cancer therapy we have successfully synthesized iron oxide nanoparticle with a characteristic cage shape (IO-NC) using the Galvanic replacement reaction starting from manganese oxide nano cube. We have demonstrated that the cavity of the IO-NC can hold anticancer drugs/RNA molecules and can successfully deliver these drugs to specific sites in vivo.[2] Moreover, when these IO-NC are coated with a lung-tropic exosome, it can effectively target and treat lung metastasis due to breast cancer.



Reference:

(1) Paragodaarachchi, A.; Medvedovsky, S.; Fang, J.; Lau, T.; Matsui, H. Iron Oxide and Various Metal Oxide Nanotubes Engineered by One-Pot Double Galvanic Replacement Based on Reduction Potential Hierarchy of Metal Templates and Ion Precursors. *RSC Adv*. **2020**, *10* (63), 38617–38620. https://doi.org/10.1039/d0ra07482a.

(2) Rampersaud, S.; Fang, J.; Wei, Z.; Fabijanic, K.; Hashimoto, A.; Hoshino, A.; Lyden, D.; Mahajan, S.; Matsui, H. The Effect of Cage Shape on Nanoparticle-Based Drug Carriers: Anticancer Drug Release and Efficacy via Receptor Blockade Using Dextran-Coated Iron Oxide Nanocages. *Nano Lett*. **2016**, *16* (12), 7357–7363. https://doi.org/10.1021/acs.nanolett.6b02577.