

Nanocages Were Utilized To Explore the Photocatalytic Removal of Various Organic Contaminants

Chen Zhang*

Department of Hematology and Oncology, Shenzhen Children's Hospital, Shenzhen, Guangdong, PR China

*Corresponding author: Chen Zhang, Department of Hematology and Oncology, Shenzhen Children's Hospital, Shenzhen, Guangdong, PR China, Email: zhangchen88@gmail.com

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Description

In the quest for health and wellness, bioactive or nutraceutical ingredients have been extensively utilized. However, their practical values were severely restricted by their unspecific delivery, poor solubility and bioavailability, and environmental instability. Ferritin protein stands out from other nanomaterials due to its distinctive shell-like structure, precise disassembly/reassembly behavior, and excellent safety profile. It is emerging as one of the most promising vehicles for the encapsulation and delivery of drugs or bioactive ingredients. From single-encapsulation, co-encapsulation, and compartmentalized encapsulation of drugs or bioactive ingredients, the most recent developments in ferritin-based delivery systems are discussed in detail in this review. The advantages and disadvantages of various cargo loading encapsulation strategies have been critically examined. This study emphasized the significance of using ferritin nanocages to create compartmentalized delivery systems, which have the potential to facilitate the synergistic functionality of a variety of cargos. Lastly, a summary of the applications of ferritin nanocages for improving the physicochemical properties and functionality of loaded cargoes is provided. In conclusion, ferritin protein nanocages are not only excellent nanocarriers but also capable of serving as "multi-seated" vehicles for the simultaneous co-encapsulation and compartmentalized encapsulation of various cargos. Due to its superior biostability and the possibility of architecture modification, the polyclodextrin-based supramolecular nanoplatform, which is crosslinked by a stimuli-responsive moiety, holds great promise for the treatment of cancer.

Supramolecular Nanocages

Covalent crosslinking of multiple -cyclodextrin molecules is used to construct the polyclodextrin supramolecular nanocages that are responsive to endogenous glutathione. Chemotherapeutic doxorubicin can be conjugated at the polyclodextrin sites. In the meantime, hydrogen bonds between -CD units and a host-guest interaction between DOX and -CD serve to stabilize the PDOP NCs. The nanocage had a high capacity for drug loading and high stability thanks to its

supramolecular cross-linked structure. Lots of GSH-touchy disulfide linkages in PDOP NCs were broken at cancer cells, advancing growth explicit DOX discharge. Also, the redox balance in growth microenvironment could be upset because of GSH exhaustion, which further sharpened the DOX impacts and reduced drug opposition, working with prompting immunogenic cell passing impact for improved chemotherapy, in this way accomplishing productive cancer concealment and delayed endurance. As a result, the adaptable supramolecular nanocage made of polyclodextrin offers a novel and effective drug delivery method for treating cancer. In water-splitting applications, the development of eco-friendly, cost-effective, and efficient electrocatalysts has become crucial and significant. A nickel-cobalt nanocage (Ni/Co-NC) electrocatalyst for Oxygen Evolution Reactions (OER) and Hydrogen Evolution Reactions (HER) was developed here using the solvothermal method. The Ni/Co-NC uncovers critical execution at a beginning capability of 350 mV for the OER at a conveyed current thickness of 10 Mama Cm⁻². XPS has confirmed that the addition of nickel to cobalt produces a significant amount of oxygen vacancies, and TEM and SEM images of the nanocage structure aid in effective OER/HER performance. Additionally, the smaller Tafel slope of 70 mV dec⁻¹ for Ni/Co-NC could be due to the synergistic effect of various Ni³⁺/Ni²⁺ and Co²⁺. Due to their porous walls, large inner and outer surfaces, and electrocatalytic activity, hollow nanocages have emerged as potential candidates for glucose biosensing applications.

The potential for HNCs to oxidize glucose has been the subject of a lot of research. However, the body of literature lacks a comprehensive review of HNC glucose biosensing applications. The synthesis and nanostructures of hollow nanocages have been the focus of the available reviews, but their electrocatalytic efficiency has not been compared. The present review has focused on HNC glucose sensing applications to address this discrepancy. This review provides a comprehensive and critical comparison of features like the stability, response times, and sensitivity of hollow nanocages for the determination of glucose, as well as a summary of the published literature on electrochemical glucose sensing methods by hollow nanocages. Moreover, the creators have suggested the most appropriate and effective metal/metal oxide for glucose detecting in light of

the hypothetical estimations utilizing Thickness Utilitarian Hypothesis. Due to its excellent structural behavior, the synthesis of metal oxides from Metal Organic Frameworks (MOFs) has taken center stage in recent years. Numerous metal oxides derived from MOF, including ZnO, NiO, Co_3O_4 , CuO, NiCo_2O_4 , and CoFe_2O_4 , has been synthesized successfully using MOFs as templates. In order to investigate the photocatalytic removal of various organic contaminants like Methylene Blue (MB), Rhodamine B (RhB), and Crystal Violet (CV), we used the hydrothermal method to prepare ZnCo_2O_4 (abbreviated as ZCO) nanocages in this report. X-Ray Diffraction (XRD) studies were used to evaluate the ZCO nanocages' structural properties. FESEM, TEM, EDS, XPS, and the UV-Visible spectrophotometer were used to perform morphological, microstructural, chemical compositional and optical characterizations, respectively.

Organic Pollutant Degradation Mechanism

Nitrogen adsorption and desorption isotherm analysis confirmed the specific surface area and pore size of ZCO nanocages. In addition, the photocatalytic removal of various organic contaminants like MB, RhB, and CV was investigated using ZCO nanocages. In addition, ZCO nanocages demonstrated remarkable photocatalytic capability for the elimination of various dye pollutants. After 180 minutes of radiation at 0.010, 0.011, and 0.012 min^{-1} rate constants (k), the kinetic studies revealed removal rates of 84.3, 87.9, and 89.5% for CV, MB, and RhB dye pollutants, respectively. Radical scavenger trapping experiments are used to investigate the significant roles that hydroxide radicals and photogenerated holes play in the organic pollutant degradation mechanism. A stability study also demonstrated that it could be recycled. As a result, the current research offers a method for creating a metal oxide derived from MOF for the photocatalytic removal of various organic pollutants. A subfamily of the ferritin protein family is called bacterioferritin. Bfrs have 24 identical subunits and self-assemble into a cage-like structure that is 43-2-fold symmetric.

Twelve heme groups are incorporated into twelve binding sites between subunits that are 2-fold symmetric. The Bfr protein cage has 62 pores that connect the interior cavity to the bulk solution outside the protein nanocage. The outer diameter of the cage is 12 nm, and the interior cavity has a diameter of 8 nm. The ferrihydrite-like mineral Bfr's interior cavity can store up to 2700 iron atoms *in vivo*. More and more Bfr structures have been solved in recent years, revealing new information about the ferroxidase center, the catalytic mechanism, the electron transfer pathway in the iron redox cycle, the possible channels by which iron ions can enter the interior cavity, and the molecular function of the heme group. Because Bfr has advantages over ferritins in controlling self-assembly and redesigning the subunit, Bfr exploration is especially appealing to researchers from a wide range of research fields because of the early applications of both mammalian and bacterial ferritins in drug delivery, imaging diagnosis, and nanoparticle vaccine. The self-assembly and genetic modification of the Bfr nanocage are the primary topics of this article, which also provides an overview of recent advancements in the molecular mechanism by which Bfr stores and releases iron. The potential applications of Bfr are further discussed based on comparisons with other members of the ferritin family. In the areas of protein nanocage design, nanomedicine, precise therapy, nanoparticle vaccine, bionanotechnology, bionanoelectronics, and so forth, we anticipate that both fundamental and applied research on Bfr will pique a great deal of interest. From a host-guest superamphiphile of a comb-like poly-cyclodextrin and an azo-functionalized prodrug, a polymeric supramolecular nanocage was constructed. In order to demonstrate the concept, *in vitro* and *in vivo* experiments were carried out, as well as interpretations of the design principle and preparation procedures. The nanocage can accomplish a long dissemination and slow medication discharge energy, however the medication delivery will be enormously advanced upon transcutaneous photograph illumination. We hope that this work will be of use in illuminating the design of non-invasive, controllable drug delivery systems.