北京理工大学

新体系教师聘期(中期)考核表

附件材料

姓　　名：_____宋宁宁_____

现聘岗位：_____预聘副教授_____

所在学科：__材料科学与工程_____

研究方向：___生物医用材料_____

所在单位：_____材料学院_____

证明材料目录

（1）发表学术论文

（2）专利成果证明

（3）科研项目

（4）承担课程信息

（5）学术兼职证明材料

（6）会议报告证明材料

（7）其他相关获奖证书

Date: Mar 09, 2024
To: "Minmin Liang" mmliang@bit.edu.cn
From: "Ping Yu" yuping@iccas.ac.cn
Subject: Your Submission

Ms. Ref. No.: **TAL-D-23-05395R1**
Title: Glutathione ligand self-assembly enables luminescence from Au15 nanoclusters for highly sensitive and selective monitoring of blood Pb(II) ions Title
Talanta

Dear Prof. Liang,

I am pleased to confirm that your paper "Glutathione ligand self-assembly enables luminescence from Au15 nanoclusters for highly sensitive and selective monitoring of blood Pb(II) ions Title" has been accepted for publication in Talanta.

Your accepted manuscript will now be transferred to our production department and work will begin on creation of the proof. If we need any additional information to create the proof, we will let you know. If not, you will be contacted again in the next few days with a request to approve the proof and to complete a number of online forms that are required for publication.

We encourage authors of original research papers to share the research objects – including raw data, methods, protocols, software, hardware and other outputs – associated with their paper. More information on how our open access Research Elements journals can help you do this is available at https://www.elsevier.com/authors/tools-and-resources/research-elements-journals?dgcid=ec_em_research_elements_email.

With kind regards,

Ping Yu
Editor
Talanta

Comments to Authors:

Reviewer #1: The concerned questions have been addressed. It could be considered for publication in the present form.

Reviewer #2: Publish

For further assistance, please visit our customer support site at http://help.elsevier.com/app/answers/list/p/7923. Here you can search for solutions on a range of topics, find answers to frequently asked questions and learn more about EM via interactive tutorials. You will also find our 24/7 support contact details should you need any further assistance from one of our customer support representatives.

At Elsevier, we want to help all our authors to stay safe when publishing. Please be aware of fraudulent messages requesting money in return for the publication of your paper. If you are publishing open access with Elsevier, bear in mind that we will never request payment before the paper has been accepted. We have prepared some guidelines (https://www.elsevier.com/connect/authors-update/seven-top-tips-on-stopping-apc-scams) that you may find helpful, including a short video on Identifying fake acceptance letters (https://www.youtube.com/watch?v=o5l8thD9XtE). Please remember that you can contact Elsevier s Researcher Support team (https://service.elsevier.com/app/home/supporthub/publishing/) at any time if you have questions about your manuscript, and you can log into Editorial Manager to check the status of your manuscript (https://service.elsevier.com/app/answers/detail/a_id/29155/c/10530/supporthub/publishing/kw/status/).
#AU_TAL#

To ensure this email reaches the intended recipient, please do not delete the above code

---

Talanta

Glutathione ligand self-assembly enables luminescence from Au15 nanoclusters for highly sensitive and selective monitoring of blood Pb(II) ions Title

--Manuscript Draft--

Manuscript Number:	TAL-D-23-05395R1
Article Type:	Research Paper
Section/Category:	Biosensors
Keywords:	Blood lead detection; Au15 nanoclusters; Luminescence probe; self-assembly; Glutathione ligand
Corresponding Author:	Minmin Liang Beijing Institute of Technology CHINA
First Author:	Chang Yuan
Order of Authors:	Chang Yuan
	Zhanjun Guo
	Shubo Tian
	Ningning Song
	Minmin Liang
Abstract:	Lead Pb(II) ions is a cumulative toxicant that impacts several biological systems and poses severe harm to young children. Accurate Pb(II) ions monitoring is thus of paramount importance. Here, we present the synthesis and application of glutathione-capped Au15 nanoclusters (Au15(SG)13) as a luminescence probe for the accurate and selective monitoring of blood Pb(II). The introduction of Pb(II) ions triggers orderly self-assembly of Au15 nanoclusters, resulting in the formation of rigid shell around Au nuclei. This limits the localized vibration of the glutathione ligands and their interaction with water molecules, greatly reducing non-radiative energy loss, and thereby enhancing the photoluminescence signal. Consequently, Au15(SG)13 nanoclusters exhibit high sensitivity for Pb(II) detection. The detection signal displays a linear relationship with Pb(II) over a wide detection range (0-800 μg/L), demonstrating a substantial sensitivity of 35.29 μg/L. Moreover, the developed nanoclusters show superior selectivity for Pb(II) ions, distinguishing them from other prevalent heavy metals. This work pave the way for the development of advanced Pb(II) sensors with high sensitivity and selectivity.

Glutathione ligand self-assembly enables luminescence from Au_{15} nanoclusters for highly sensitive and selective monitoring of blood Pb(II) ions

Chang Yuan[1], Zhanjun Guo[1], Shubo Tian[2], Ningning Song[1*], and Minmin Liang[1*]

[1]Experimental Center of Advanced Materials, School of Materials Science & Engineering, Beijing Institute of Technology, Beijing, China

[2]State Key Laboratory of Chemical Resource Engineering, Beijing Advanced Innovation Centre for Soft Matter Science and Engineering, Beijing University of Chemical Technology, Beijing, China

*Correspondence to:

Ningning Song, PhD. Email: songningning@bit.edu.cn

Minmin Liang, PhD. Email: mmliang@bit.edu.cn

ADVANCED HEALTHCARE MATERIALS
www.advhealthmat.de

Arginine-Enhanced Antimicrobial Activity of Nanozymes against Gram-Negative Bacteria

Zihan Zhao, Shu'an Wen, Ningning Song, Lixiang Wang, Yuan Zhou, Xue Deng, Changbu Wu, Guili Zhang, Jun Chen, Guo-Bao Tian, Minmin Liang,* and Lan-Lan Zhong**

The continuous reduction of clinically available antibiotics has made it imperative to exploit more effective antimicrobial therapies, especially for difficult-to-treat Gram-negative pathogens. Herein, it is shown that the combination of an antimicrobial nanozyme with the clinically compatible basic amino acid L-arginine affords a potent treatment for infections with Gram-negative pathogens. In particular, the antimicrobial activity of the antimicrobial nanozyme is dramatically increased by ≈1000-fold after L-arginine stimulation. Specifically, the combination therapy enhances bacterial outer and inner membrane permeability and promotes intracellular reactive oxygen species (ROS) generation. Moreover, the metabolomic and transcriptomic results reveal that combination treatment leads to the increased ROS-mediated damage by inhibiting the tricarboxylic acid cycle and oxidative phosphorylation, thereby inducing an imbalance of the antioxidant and oxidant systems. Importantly, L-arginine dramatically significantly accelerates the healing of infected wounds in mouse models of multidrug-resistant peritonitis-sepsis and skin wound infection. Overall, this work demonstrates a novel synergistic antibacterial strategy by combining the antimicrobial nanozymes with L-arginine, which substantively facilitates the nanozyme-mediated killing of pathogens by promoting ROS production.

1. Introduction

In recent decades, bacterial infections have been recognized as a serious threat to public health.[1–3] This is a particular challenge for infections caused by Gram-negative bacteria, as these organisms possess a protective outer membrane composed of lipopolysaccharides (LPS) that renders them resistant to many antibiotics and other therapeutic agents.[4–6] Despite the efficacy of chemically synthesized and conventional natural antibiotics against Gram-negative bacteria,[7–9] the emergence of multidrug-resistant (MDR) strains and so-called "superbacteria" poses a grave threat to the survival of millions of people worldwide.[10–12] Thus, there is an urgent need for more effective antibacterial strategies to combat infections with Gram-negative bacteria.

The development of nanozymes with intrinsic enzyme-like properties has offered new opportunities to solve the clinical challenge of treating infections with MDR

Z. Zhao, S. Wen, Y. Zhou, X. Deng, C. Wu, G. Zhang, G.-B. Tian, L.-L. Zhong
Program in Pathobiology
The Fifth Affiliated Hospital
Zhongshan School of Medicine
Sun Yat-Sen University
Guangdong 510080, China
E-mail: tiangb@mail.sysu.edu.cn; zhongll6@mail.sysu.edu.cn

Z. Zhao, S. Wen, Y. Zhou, X. Deng, C. Wu, G. Zhang, G.-B. Tian, L.-L. Zhong
Advanced Medical Technology Center
The First Affiliated Hospital
Zhongshan School of Medicine
Sun Yat-sen University
Guangzhou 510080, China

Z. Zhao, S. Wen, Y. Zhou, X. Deng, C. Wu, G. Zhang, G.-B. Tian, L.-L. Zhong
State Key Laboratory of Oncology in South China
Sun Yat-sen University Cancer Center
Guangzhou 510060, P. R. China

The ORCID identification number(s) for the author(s) of this article can be found under https://doi.org/10.1002/adhm.202301332

DOI: 10.1002/adhm.202301332

Z. Zhao, S. Wen, Y. Zhou, X. Deng, C. Wu, G. Zhang, G.-B. Tian, L.-L. Zhong
Key Laboratory of Tropical Diseases Control (Sun Yat-sen University)
Ministry of Education
Guangzhou 510080, China

Z. Zhao
Department of Clinical Laboratory
Shenzhen People' s Hospital (Second Clinical Medical College
Jinan University; The First Affiliated Hospital
Southern University of Science and Technology)
Shenzhen 518020, China

N. Song, M. Liang
Experimental Center of Advanced Materials
School of Materials Science & Engineering
Beijing Institute of Technology
Beijing 100081, China
E-mail: mmliang@bit.edu.cn

L. Wang, J. Chen
Department of Immunology and Microbiology
Zhongshan School of Medicine
Sun Yat-sen University
Guangzhou 510080, China

kidney, and lung samples were collected. The remaining mice in each group were used to record survival rates for 72 h.

Detection of IL-6 and TNF-α: Blood samples (100 µL) were collected from each mouse. The concentrations of IL-6 and TNF-α were quantified by mouse IL-6 ELISA kits (EMC004, QuantiCyto) and TNF-α (EMC102a, QuantiCyto) enzyme-linked immunosorbent assay kits, respectively. All measurements were strictly carried out following the procedures provided by the manufacturers.

Histological Analysis: The treated mice were sacrificed on therapeutic day 14. The wound tissues were harvested and fixed with a paraformaldehyde solution (4%). The tissues were paraffined, sectioned, and analyzed by Masson's trichrome staining (Servicebio G1006, China) and H&E staining (Servicebio G1003, China).

Ethics: All procedures involving experimental animals were performed in accordance with protocols approved by the Committee for Animal Research of Sun Yat-sen University, China (Approval No. 2021044).

Statistical Analysis: Statistical analyses were carried out and data were visualized using GraphPad Prism v8. Kaplan–Meier survival analysis and Matel–Cox test were employed and plotted. The differences among multiple treatments were determined by one-way ANOVA followed by a *t*-test with Holm–Sidak correction, while for differences between two groups, t-test was performed; $P < 0.05$ indicated statistical significance unless otherwise noted. Data in all figures represent means ± standard deviations. At least three biological replicates per experiment were carried out. *P* values: $*P < 0.05$, $**P < 0.01$, $***P < 0.001$, $****P < 0.0001$, ns (no significant difference), $P > 0.05$.

Supporting Information

Supporting Information is available from the Wiley Online Library or from the author.

Acknowledgements

Z.Z., S.W., and N.S. contributed equally to this work. This work was supported by the National Natural Science Foundation of China (grant number 82325033, 81830103, 82061128001 to G.-B T; 82372294 to L.-LZ.), Guangdong Natural Science Foundation (grant number 2017A030306012 to G.-B T.), and Project of High-level Health Teams of Zhu hai in 2018 (The Innovation Team for Antimicrobial Resistance and Clinical Infection to G.-BT.).

Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

Research data are not shared.

Keywords

bacterial infections, gram-negative pathogens, L-arginine, nanozymes, nanozyme adjuvants

Received: April 26, 2023
Revised: October 31, 2023
Published online: November 27, 2023

[1] J. L. Fraser, A. Mwatondo, Y. H. Alimi, J. K. Varma, V. J. D. R Vilas, *Int. J. Infect. Dis.* **2021**, *103*, 469.
[2] B. Aslam, M. Khurshid, M. I. Arshad, S. Muzammil, M. Rasool, N. Yasmeen, T. Shah, T. H. Chaudhry, M. H. Rasool, A. Shahid, X. Xueshan, Z. Baloch, *Front. Cell Infect. Microbiol.* **2021**, *11*, 771510.
[3] D. Ghosh, B. Veeraraghavan, R. Elangovan, P. Vivekanandan, *Antimicrob. Agents Chemother.* **2020**, *64*, 02225.
[4] J.-M. Pagès, C. E. James, M. Winterhalter, *Nat. Rev. Microbiol.* **2008**, *6*, 893.
[5] J. P. Mills, D. Marchaim, *Infect. Dis. Clin. North Am.* **2021**, *35*, 969.
[6] C. L. Holmes, M. T. Anderson, H. L. T. Mobley, M. A. Bachman, *Clin. Microbiol. Rev.* **2021**, *34*, e00234.
[7] S. Bhardwaj, P. Mehra, D. S. Dhanjal, P. Sharma, V. Sharma, R. Singh, E. Nepovimova, C. Chopra, K. Kuca, *Curr. Pharm. Des.* **2022**, *28*, 2312.
[8] K. S. Singh, R. Sharma, P. A. N. Reddy, P. Vonteddu, M. Good, A. Sundarrajan, H. Choi, K. Muthumani, A. Kossenkov, A. R. Goldman, H.-Y. Tang, M. Totrov, J. Cassel, M. E. Murphy, R. Somasundaram, M. Herlyn, J. M. Salvino, F. Dotiwala, *Nature* **2021**, *599*, 518.
[9] C. Ghose, C. W. Euler, *Antibiotics* **2020**, *9*, 74.
[10] P. Nordmann, L. Poirel, *Clin. Infect. Dis.* **2019**, *69*, S521-S8.
[11] S. H. Zinner, *New Microbiol.* **2007**, *30*, 321.
[12] S.-S. Jean, D. Harnod, P.-R. Hsueh, *Front. Cell Infect. Microbiol.* **2022**, *12*, 823684.
[13] L. Gao, L. Chen, R. Zhang, X. Yan, *Zhongguo Kexue: Huaxue* **2022**, *52*, 1649.
[14] M. Liang, X. Yan, *Acc. Chem. Res.* **2019**, *52*, 2190.
[15] D. Wang, D. Jana, Y. Zhao, *Acc. Chem. Res.* **2020**, *53*, 1389.
[16] C. Zhou, Q. Wang, J. Jiang, L. Gao, *Antibiotics* **2022**, *11*, 390.
[17] Y. Huang, J. Ren, X. Qu, *Chem. Rev.* **2019**, *119*, 4357.
[18] H. Wang, K. Wan, X. Shi, *Adv. Mater.* **2019**, *31*, 1805368.
[19] Y. Chen, P. Wang, H. Hao, J. Hong, H. Li, S. Ji, A. Li, R. Ren, J. Dong, X. Hang, M. Liang, D. Wang, Y. Li, J. Am, *Chem. Soc.* **2021**, *143*, 1864.
[20] Y. Chen, B. Jiang, H. Hao, H. Li, C. Qiu, X. Liang, Q. Qu, Z. Zhang, R. Gao, D. Duang, S. Ji, D. Wang, M. Liang, *Angew. Chem. Int. Ed.* **2023**, e202301879.
[21] N. Chakraborty, S. Gandhi, R. Verma, I. Roy, *Biomedicines* **2022**, *10*, 1378.
[22] Y. Liu, N. Nie, H. Tang, C. Zhang, K. Chen, W. Wang, J. Liu, *ACS Appl. Mater. Interfaces* **2021**, *13*, 11631.
[23] Q. Wang, J. Jiang, L. Gao, *Wiley Interdiscip. Rev.: Nanomed. Nanobiotechnol.* **2022**, *14*, e1769.
[24] F. Mo, M. Zhang, X. Duan, C. Lin, D. Sun, T. You, *Int. J. Nanomed.* **2022**, *17*, 5947.
[25] H. Wei, E. Wang, *Chem. Soc. Rev.* **2013**, *42*, 6060.
[26] S. Ning, Y. Zheng, K. Qiao, G. Li, Q. Bai, S. Xu, *J. Nanobiotechnol.* **2021**, *19*, 344.
[27] C. Liu, J. Xing, O. U. Akakuru, L. Luo, S. Sun, R. Zou, Z. Yu, Q. Fang, A. Wu, *Nano Lett.* **2019**, *19*, 5674.
[28] P. Mazur, I. Skiba-Kurek, P. Mrowiec, E. Karczewska, R. Drozdz, *Int. J. Nanomedicine* **2020**, *15*, 3551.
[29] T. Bruna, F. Maldonado-Bravo, P. Jara, N. Caro, *Int. J. Mol. Sci.* **2021**, *22*, 202.
[30] A. Rogowska, K. Rafinska, P. Pomastowski, J. Walczak, V. Railean-Plugaru, M. Buszewska-Forajta, B. Buszewski, *Electrophoresis* **2017**, *38*, 2757
[31] G. Wan, L. Ruan, Y. Yin, T. Yang, M. Ge, X. Cheng, *Int. J. Nanomed.* **2016**, *11*, 3789.
[32] X.-L. Zhao, Z.-G. Chen, T-C. Yang, M. Jiang, J. Wang, Z.-X. Cheng, M.-J. Yang, J.-X. Zhu, T.-T. Zhang, H. Li, B. Peng, X.-X. Peng, *Sci. Transl. Med.* **2021**, *13*, eabj0716.
[33] D. Lebeaux, A. Chauhan, S. Létoffé, F. Fischer, H. De Reuse, C. Beloin, J.-M. Ghigo, *J. Infect. Dis.* **2014**, *210*, 1357.
[34] W. Y. Chung, Y. Zhu, M. H. Mahamad Maifiah, N. K. Hawala Shivashekaregowda, E. H. Wong, N. Abdul Rahim, *Metabolomics* **2022**, *18*, 47.

Research Article

Nano Research
2024, 17(5): 3942–3949

ISSN 1998-0124 CN 11-5974/O4
https://doi.org/10.1007/s12274-023-6399-y

A functional hydrogenase mimic that catalyzes robust H_2 evolution spontaneously in aqueous environment

Ningning Song[1,§], Zhanjun Guo[1,§], Shuo Wang[2,§], Yongli Li[1], Yunpeng Liu[3], Meishuai Zou[2] (✉), and Minmin Liang[1] (✉)

[1] *Experimental Center of Advanced Materials, School of Materials Science & Engineering, Beijing Institute of Technology, Beijing 100081, China*
[2] *School of Materials Science & Engineering, Beijing Institute of Technology, Beijing 100081, China*
[3] *Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China*
[§] *Ningning Song, Zhanjun Guo, and Shuo Wang contributed equally to this work.*

Received: 24 October 2023 / **Revised:** 4 December 2023 / **Accepted:** 6 December 2023

ABSTRACT

Although great progress has been made in improving hydrogen production, highly efficient catalysts, which are able to produce hydrogen in a fast and steady way at ambient temperature and pressure, are still in large demand. Here, we report a [NiCo]-based hydrogenase mimic, $NiCo_2O_4$ nanozyme, that can catalyze robust hydrogen evolution spontaneously in water without external energy input at room temperature. This hydrogenase nanozyme facilitates water splitting reaction by forming a three-center Ni–OH–Co bond analogous to the [NiFe]-hydrogenase reaction by using aluminum as electron donor, and realizes hydrogen evolution with a high production rate of 915 $L \cdot h^{-1}$ per gram of nanozymes, which is hundreds of times higher than most of the natural hydrogenase or hydrogenase mimics. Furthermore, the $NiCo_2O_4$ nanozyme can robustly disrupt the adhesive oxidized layer of aluminum and enable the full consumption of electrons from aluminum. In contrast to the often-expensive synthetic catalysts that rely on rare elements and consume high energy, we envision that this $NiCo_2O_4$ nanozyme can potentially provide an upgrade for current hydrogen evolution, accelerate the development of scale-up hydrogen production, and generate a clean energy future.

KEYWORDS

hydrogenase mimic, nanozyme, hydrogen evolution reaction, aluminum activation, water-splitting

1 Introduction

Hydrogen (H_2), as a clean energy carrier with high energy density, is becoming an important alternative fuel nowadays. However, the majority of the hydrogen is produced through steam reforming of natural gas, an endothermic procedure, which requires massive heat supply and induces carbon dioxide emissions [1, 2]. Green productions of hydrogen, through either electrolysis of water using renewable electricity [3–5], direct solar-driven water splitting process [6–8], or metal-water hydrogen production techniques [9–11], are in rapid development. Especially, the metal-aided water splitting process has stimulated widespread interest in the scenarios where the instant hydrogen generation is needed. Among which, aluminum (Al), as one of the most abundant metals on earth, has been widely used [12]. However, Al itself cannot react continuously with water due to the formation of dense oxide layer barrier on the surface [13, 14]. Current strategies to overcome this problem include hydroxide, oxide, and salt promoters with the best performance from hydroxide promoters [14]. Despite those efforts, the Al-water reaction is still severely incomplete, leading to Al remaining in the residues. Therefore, there is an urgent need for developing highly effective catalysts that can accelerate water splitting reaction, activate Al thoroughly, and eventually achieve high-yield hydrogen evolution.

Hydrogenases, as the nature-evolved, extremely efficient enzymes, can reversibly catalyze the interconversion of protons and hydrogen with high turnover frequencies around 10^3 s^{-1} and are the most efficient noble-metal-free hydrogen production catalysts [6, 15, 16]. There are three different types of hydrogenases identified so far: Fe only hydrogenase, [NiFe]-hydrogenase, which contains heterometallic reaction center Ni-Fe, and [FeFe]-hydrogenase with di-iron catalytic center [17, 18]. It is noteworthy that the active sites of [NiFe]-hydrogenase have high affinity toward hydroxy ligand(s) [19], making it a promising promoter of the Al-water reaction. However, hydrogenase catalytic activity is prone to temperature, pH, and sometimes oxygen, leading to great limitations on their applications from energy generation to industrial synthesis [20].

Nanozymes, generally defined as nanomaterials mimicking enzyme activities, are becoming a promising new type of catalyst owing to their high stability, low cost, and tunable catalytic activity [21–26]. $NiCo_2O_4$, owing to its unique Ni-Co bimetallic active sites, has strong affinity to hydroxyl group [27], which could be a potential mimic for [NiFe]-hydrogenase. Accordingly, in this work, we developed a [NiCo]-based hydrogenase mimic, $NiCo_2O_4$ nanozyme, by ball milling the $NiCo_2O_4$ nanofibers with Al alloy powders. The as prepared nanozyme significantly enhances the water splitting reaction by forming a three-center Ni–OH–Co

Address correspondence to Meishuai Zou, zoums@bit.edu.cn; Minmin Liang, mmliang@bit.edu.cn

Nano Research
2023, 16(8): 10763–10769

ISSN 1998-0124 CN 11-5974/O4
https://doi.org/10.1007/s12274-023-5760-5

Research Article

Multiscale structural design of MnO_2@GO superoxide dismutase nanozyme for protection against antioxidant damage

Yue Yu[1], Yinuo Zhang[1], Yu Wang[2], Wenxing Chen[3], Zhanjun Guo[1] (✉), Ningning Song[1] (✉), and Minmin Liang[1] (✉)

[1] *Experimental Center of Advanced Materials, School of Materials Science & Engineering, Beijing Institute of Technology, Beijing 100081, China*
[2] *Shanghai Synchrotron Radiation Facilities, Shanghai Institute of Applied Physics, Chinese Academy of Science, Shanghai 201204, China*
[3] *Beijing Key Laboratory of Construction Tailorable Advanced Functional Materials and Green Applications, School of Materials Science and Engineering, Beijing Institute of Technology, Beijing 100081, China*

Received: 10 March 2023 / **Revised:** 11 April 2023 / **Accepted:** 19 April 2023

ABSTRACT

Rational design of metallic active sites and its microenvironment is critical for constructing superoxide dismutase (SOD) nanozymes. Here, we reported a novel SOD nanozyme design, with employing graphene oxide (GO) as the framework, and δ-MnO_2 as the active sites, to mimic the natural Mn-SOD. This MnO_2@GO nanozyme exhibited multiscale laminated structures with honeycomb-like morphology, providing highly specific surface area for $\cdot O_2^-$ adsorption and confined spaces for subsequent catalytic reactions. Thus, the nanozyme achieved superlative SOD-like catalytic performance with inhibition rate of 95.5%, which is 222.6% and 1605.4% amplification over GO and MnO_2 nanoparticles, respectively. Additionally, such unique hierarchical structural design endows MnO_2@GO with catalytic specificity, which was not present in the individual component (GO or MnO_2). This multiscale structural design provides new strategies for developing highly active and specific SOD nanozymes.

KEYWORDS

MnO_2@graphene oxide (MnO_2@GO) nanozyme, superoxide dismutase (SOD)-like activity, activity, specificity, antioxidation

1 Introduction

Superoxide anion radical ($\cdot O_2^-$), as a primary form of reactive oxygen species (ROS), possesses the most active properties [1, 2]. $\cdot O_2^-$ is produced by one electron reduction of O_2 and mainly generated in the mitochondria of cells through metabolic processes or irradiations [3]. Its excessive presence can lead to oxidative stress, eventually inducing cellular impairments through DNA, protein, and/or lipid oxidative damages [4–6]. Superoxide dismutase (SOD) is a class of enzyme that catalyzes the dismutation reaction of $\cdot O_2^-$ into O_2 and H_2O_2 [7, 8], which is regarded as a strong antioxidant protecting cells against damages from ROS [9, 10]. So far many types of SOD have been identified, with Cu/Zn-SOD and Mn-SOD as the most common types [11]. Pharmacokinetic studies revealed that natural Mn-SOD is superior to Cu/Zn-SOD for chronic diseases treatment, in terms of its longer half-life time in 5–6 h [12]. However, the practical applications of natural SOD are still limited due to their denaturation, high cost, laborious preparations, and difficulties in recycling [13, 14].

Nanozymes, nanomaterials with enzyme-like activities, have been widely applied in various biomedical fields [15, 16], owing to their underlying properties, such as high and tunable catalytic activities, low cost to produce, easy large-scale production, and high stability. Specifically, most of nanozymes with SOD-like activity consist of transition metal centers such as Ce, Au, Cu, Mn, Ni, Co, Fe, or their oxides, carbides, nitrides, or sulfides [2]. It has been shown that overexpression of Mn-SOD, other than Cu/Zn-SOD, in mammalian cells can significantly enhance the cells' resistance to radiation damages [17], which thus promote the long-term efforts for the development of Mn-SOD mimics. Mn-based SOD mimics, which focus on their similar active-site composites to the natural enzyme, have been modulated through regulating sizes, shapes, or compositions of nanozymes [18, 19]. However, in natural Mn-SOD, not only the active site metal centers contribute to the high catalytic activity, but also the confined substrate channel and reaction space formed by the amino acid residues [20]. Methods, focusing on the active centers, have been utilized to increase nanozymes' activities [21, 22]. Therefore, to better mimic the natural enzymes and further improve their catalytic performance, more efforts should be directed to design the micro/nano structure and the chemical bonding environment of SOD nanozymes. Graphene oxide (GO), an atomically thin layer of graphite, is functionalized by numerous oxygen-containing functional groups on the basal plane and the edges, allowing it to interact with other compounds via covalent binding and/or stabilize reaction intermediates by electrostatic interactions [23, 24]. Such unique properties make GO a promising substrate for SOD nanozyme design.

Herein, we report a rational design of SOD nanozyme with GO as the framework, and δ-MnO_2 as the active component (MnO_2@GO), mimicking the active center, microenvironment,

Address correspondence to Zhanjun Guo, guozhanjun@bit.edu.cn; Ningning Song, songningning@bit.edu.cn; Minmin Liang, mmliang@bit.edu.cn

ADVANCED MATERIALS
www.advmat.de

Bioinspired Hierarchical Self-Assembled Nanozyme for Efficient Antibacterial Treatment

Ningning Song, Yue Yu, Yinuo Zhang, Zhengdi Wang, Zhanjun Guo, Jianlin Zhang, Changbin Zhang, and Minmin Liang**

Along with the rapid development and ever-deepening understanding of nanoscience and nanotechnology, nanomaterials hold promise to mimic the highly evolved biological exquisite nanostructures and sophisticated functions. Here, inspired by the ubiquitous antibacterial nanostructures on the wing surfaces of some insects, a $NiCo_2O_4$ nanozyme with self-adaptive hierarchical nanostructure is developed that can capture bacteria of various morphotypes via the physico-mechanical interaction between the nanostructure and bacteria. Moreover, the developed biomimetic nanostructure further exhibits superior peroxidase-like catalytic activity, which can catalytically generate highly toxic reactive oxygen species that disrupt bacterial membranes and induce bacterial apoptosis. Therefore, the mechano-catalytic coupling property of this $NiCo_2O_4$ nanozyme allows for an extensive and efficient antibacterial application, with no concerns of antimicrobial resistance. This work suggests a promising strategy for the rational design of advanced antibacterial materials by mimicking biological antibiosis.

1. Introduction

Nature endows life with a wide variety of sophisticated, synergistic, and highly functional nanostructures.[1–3] For example, the hierarchical nanostructures on the wing surfaces of some insects such as dragonfly and cicada, can capture bacteria and subsequently mechanically rupture bacterial membranes via the physico-mechanical interaction between the wing nanostructures and bacteria, and thus emerge the outstanding antibacterial performance.[4–6] Over the past couple of decades, significant progress in the development of nanoscience and nanotechnology has achieved the design and fabrication of a broad variety of highly ordered biological nanostructures and sophisticated functions.[7–10] Especially, following Nature's inspiration to assemble biomimetic antibacterial nanomaterials is emerging as a fascinating research field.[5,11–13] Recently, nanomaterials with enzyme-like properties, termed nanozymes, have been extensively reported for antibacterial application via biomimetic catalysis of reactive oxygen species generation that disrupts bacterial membranes and induces bacterial apoptosis.[14–16] However, despite the obvious advantages of nanozymes such as high stability, low cost, recyclable utilization and multifunction, the unfavorable antibacterial activity in contrast to traditional antibiotics necessitates the further innovation of biomimetic nanozymes.

In this work, we develop a $NiCo_2O_4$ nanozyme with self-assembled three-level hierarchical nanostructures (including nanofibers, nanopetals, and nanoflowers) by mimicking the nanocone array structures on the wing surfaces of some insects such as dragonfly and cicada for antibacterial treatment (**Figure 1**a). We demonstrate that the developed $NiCo_2O_4$ nanozyme shows outstanding antibacterial performance via the combination of mechanical rupture of bacteria by the surface nanocone topographies and catalytic oxidation by the peroxidase-like activity of the metal active sites on $NiCo_2O_4$ nanozyme (Figure 1b). Interestingly, the mechano-catalytic coupling effect of the nanozyme exhibits self-adaptive biomimetic nanostructure that can capture bacteria of various morphotypes and thus allow for an extensive antibacterial application. Specifically, the rigid nanopetal-shaped structure of the nanozyme can penetrate deeply through the bacteria with thin cell walls consisting of peptidoglycan (e.g., *Escherichia coli*); while for the bacteria with thick rigid walls (e.g., *Staphylococcus aureus*), the nanozyme will tune its structure to flexible nanofibers to efficiently capture the bacteria. Therefore, inspired by nature, rational design of nanozymes is a promising strategy for engineering high-performance antibacterial materials.

2. Results and Discussion

2.1. Synthesis and Characterization of $NiCo_2O_4$ Nanozyme

The synthesis of $NiCo_2O_4$ nanozyme is schematically illustrated in **Figure 2**a. The nanomaterial was thoroughly characterized by various methods. Scanning electron microscopy (SEM)

N. Song, Y. Yu, Y. Zhang, Z. Wang, Z. Guo, J. Zhang, M. Liang
Experimental Center of Advanced Materials
School of Materials Science & Engineering
Beijing Institute of Technology
Beijing 100081, China
E-mail: mmliang@bit.edu.cn

C. Zhang
Research Center for Eco-Environmental Sciences
Chinese Academy of Sciences
Beijing 100085, China
E-mail: cbzhang@rcees.ac.cn

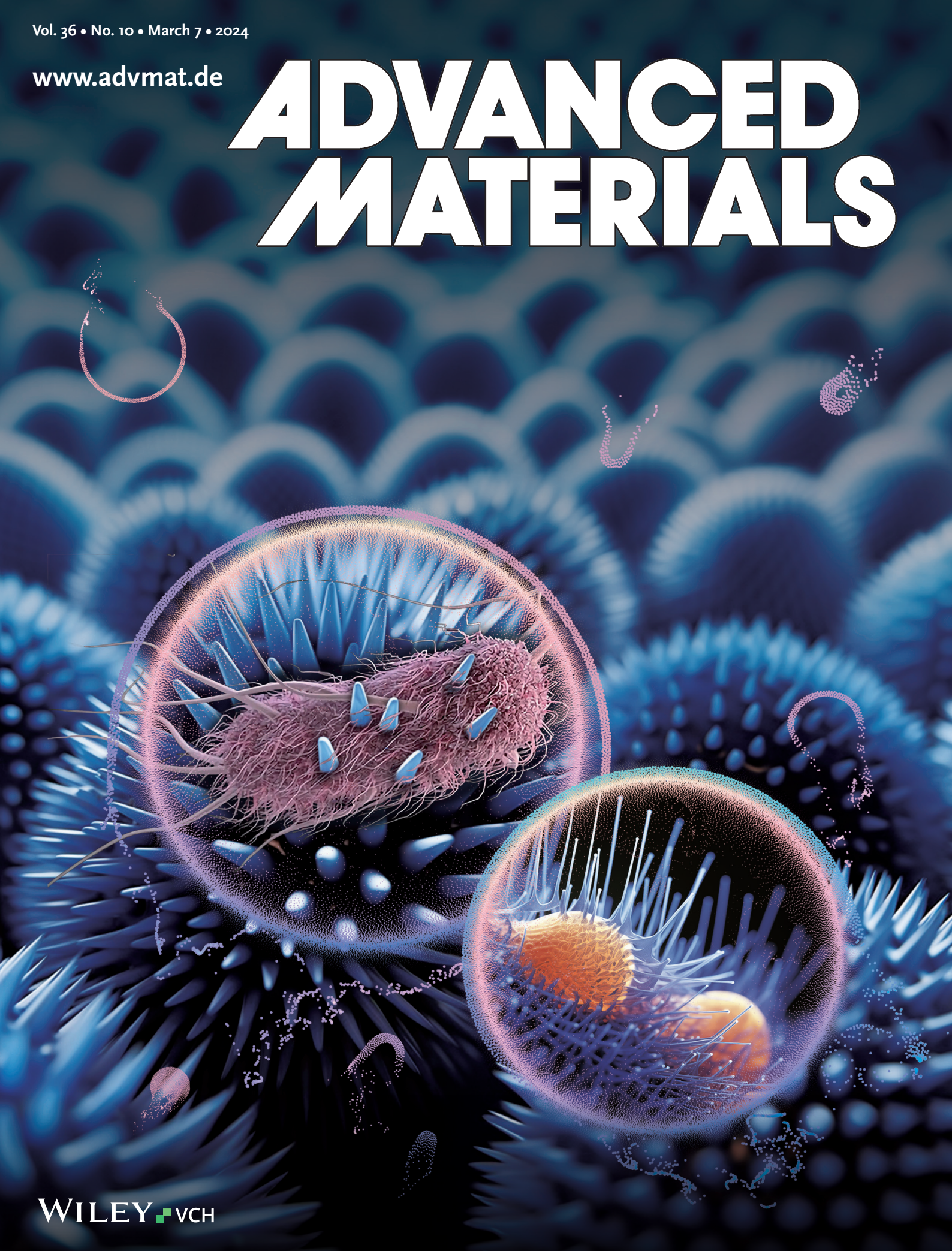
The ORCID identification number(s) for the author(s) of this article can be found under https://doi.org/10.1002/adma.202210455.

DOI: 10.1002/adma.202210455

Vol. 36 • No. 10 • March 7 • 2024

www.advmat.de

ADVANCED MATERIALS



WILEY VCH

analytical chemistry

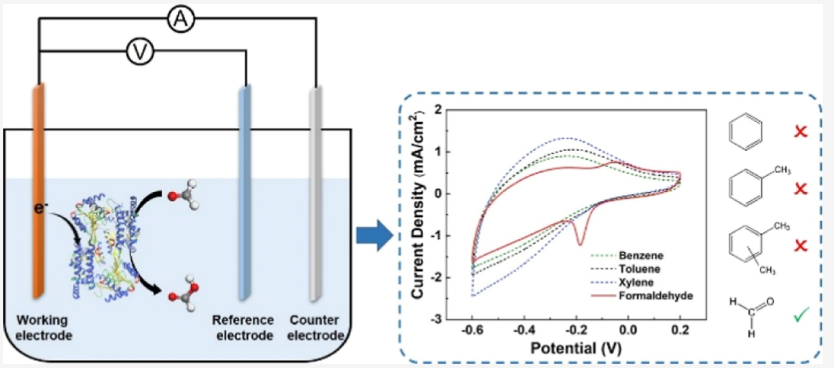
pubs.acs.org/ac Article

Highly Sensitive and Selective Detection of Formaldehyde via Bio-Electrocatalysis over Aldehyde Dehydrogenase

Yinuo Zhang, Yue Yu, Changbin Zhang, Ningning Song,* Zhanjun Guo,* and Minmin Liang*

Cite This: https://doi.org/10.1021/acs.analchem.2c03632 Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information



ABSTRACT: Formaldehyde (HCHO), as one of the prominent indoor pollutants, causes many health-related problems. Although the detection of HCHO is a widespread concern and a variety of detection methods have been continuously developed, the volatile organic chemical (VOC) interference remains to be solved. Here, we report a highly sensitive and selective method for HCHO detection, relying on the selective electrochemical oxidation of formaldehyde catalyzed by aldehyde dehydrogenases (ALDHs) on a Cu electrode. The detection signal exhibits a standard power law relationship against the analytes with a broad detection range of 10^{-5}–10^{-15} M and a limit of detection (LOD) of 1.46×10^{-15} M, far below the indoor safe exposure limit (about 10^{-9} M) for formaldehyde. In comparison to the standard spectrophotometry method, the ALDH-based electrochemical method shows a much high specificity to formaldehyde among common VOCs, such as benzene, toluene, and xylene. This simple yet effective detection technique opens up a new path for developing advanced formaldehyde sensors with high sensitivity and selectivity.

INTRODUCTION

Formaldehyde (HCHO), an important precursor widely used in various manufacturing processes for chemicals, furniture, and paints, is causing various health-related concerns to human being.[1,2] It is now considered as one of the largest indoor pollutants and classified as a Group 1 carcinogen by the World Health Organization.[3] Exposure to low concentration (as low as 0.1 ppm) of formaldehyde in an indoor environment can induce adverse health impacts, such as irritations to the skin and mucous membranes.[1] Longer exposure can even cause headache, dizziness, fatigue, nausea, vomiting, chest tightness, and other worse symptoms.[4] However, the detections for HCHO are severely interfered by the volatile organic chemicals (VOCs) such as benzene, toluene, xylene, and so forth, which are also the major contributors to the indoor air pollutants.[5] Therefore, a simple detection method with high sensitivity and specificity is desired for quick and accurate assessment of indoor formaldehyde. Analytical methods currently developed for formaldehyde mainly include gas/liquid chromatography,[6,7] spectrophotometry,[8] fluorometry,[9−11] and sensors.[12−14] While these methods served their goals of detecting formaldehyde, a majority of those require long preparation time, unstable chemicals, or expensive equipment and sometimes lack specificity. Electrochemical sensors for formaldehyde detections, owing to their low cost and facile operations properties, have attracted much interest recently. However, owing to the narrow detection range and interferences of other indoor VOCs, the performance of current devices is inferior to that of the chromatography or spectrometry methods.

Aldehyde dehydrogenases (ALDHs) are a class of enzymes that can convert acetaldehyde and other aldehydes into acids.[15,16] Due to its relatively high stability and ease to purify over formaldehyde dehydrogenase, we utilized ALDH in this work, together with the copper electrode to construct bio-electrocatalysis for the detection of formaldehyde. The setup

Received: August 19, 2022
Accepted: October 21, 2022

ACCOUNTS of chemical research

pubs.acs.org/accounts Article

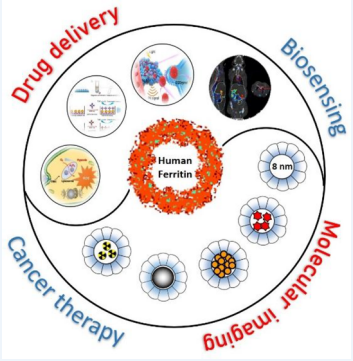
Ferritin: A Multifunctional Nanoplatform for Biological Detection, Imaging Diagnosis, and Drug Delivery

Ningning Song,[§] Jianlin Zhang,[§] Jiao Zhai,[§] Juanji Hong, Chang Yuan, and Minmin Liang*

Cite This: *Acc. Chem. Res.* 2021, 54, 3313−3325 Read Online

ACCESS | Metrics & More | Article Recommendations

CONSPECTUS: Ferritins are spherical iron storage proteins within cells that are composed of a combination of 24 subunits of two types, heavy-chain ferritin (HFn) and light-chain ferritin (LFn). They autoassemble naturally into a spherical hollow nanocage with an outer diameter of 12 nm and an interior cavity that is 8 nm in diameter. In recent years, with the constantly emerging safety issues and the concerns about unfavorable uniformity and indefinite *in vivo* behavior of traditional nanomedicines, the characteristics of native ferritin nanocages, such as the unique nanocage structure, excellent safety profile, and definite *in vivo* behavior, make ferritin-based formulations uniquely attractive for nanomedicine development. To date, a variety of cargo molecules, including therapeutic drugs (*e.g.*, cisplatin, carboplatin, paclitaxel, curcumin, atropine, quercetin, gefitinib, daunomycin, epirubicin, doxorubicin, etc.), imaging agents (*e.g.*, fluorescence dyes, radioisotopes, and MRI contrast agents), nucleic acids (*e.g.*, siRNA and miRNA), and metal nanoparticles (*e.g.*, Fe_3O_4, CeO_2, AuPd, CuS, CoPt, FeCo, Ag, etc.) have been loaded into the interior cavity of ferritin nanocages for a broad range of biomedical applications from *in vitro* biosensing to targeted delivery of cargo molecules in living systems with the aid of modified targeting ligands either genetically or chemically. We reported that human HFn could selectively deliver a large amount of cargo into tumors *in vivo via* transferrin receptor 1 (TfR1)-mediated tumor-cell-specific targeting followed by rapid internalization. By the use of the intrinsic tumor-targeting property and unique nanocage structure of human HFn, a broad variety of cargo-loaded HFn formulations have been developed for biological analysis, imaging diagnosis, and medicine development. In view of the intrinsic tumor-targeting property, unique nanocage structure, lack of immunogenicity, and definite *in vivo* behavior, human HFn holds promise to promote therapeutic drugs, diagnostic imaging agents, and targeting moieties into multifunctional nanomedicines.



Since the report of the intrinsic tumor-targeting property of human HFn, we have extensively explored human HFn as an ideal nanocarrier for tumor-targeted delivery of anticancer drugs, MRI contrast agents, inorganic nanoparticles, and radioisotopes. In particular, by the use of genetic tools, we also have genetically engineered human HFn nanocages to recognize a broader range of disease biomarkers. In this Account, we systematically review human ferritins from characterizing their tumor-binding property and understanding their mechanism and kinetics for cargo loading to exploring their biomedical applications. We finally discuss the prospect of ferritin-based formulations to become next-generation nanomedicines. We expect that ferritin formulations with unique physicochemical characteristics and intrinsic tumor-targeting property will attract broad interest in fundamental drug research and offer new opportunities for nanomedicine development.

KEY REFERENCES

- Fan, K.; Cao, C.; Pan, Y.; Lu, D.; Yang, D.; Feng, J.; Song, L.; Liang, M.; Yan, X. Magnetoferritin nanoparticles for targeting and visualizing tumor tissues. *Nat. Nanotechnol.* **2012**, *7*, 459−464.[1] *Iron oxide encapsulated into ferritin nanoparticles was used to target and visualize tumor tissues simultaneously.*
- Liang, M.; Fan, K.; Zhou, M.; Duan, D.; Zheng, J.; Yang, D.; Feng, J.; Yan, X. H-ferritin-nanocaged doxorubicin nanoparticles specifically target and kill tumors with a single-dose injection. *Proc. Natl. Acad. Sci. U. S. A.* **2014**, *111*, 14900−14905.[2] *Natural H-ferritin nanocages delivered a high concentration of doxorubicin to tumor cells and significantly inhibited tumor growth with a single-dose treatment.*
- Liang, M.; Tan, H.; Zhou, J.; Wang, T.; Duan, D.; Fan, K.; He, J.; Cheng, D.; Shi, H.; Choi, H. S.; Yan, X. Bioengineered H-ferritin nanocages for quantitative imaging of vulnerable plaques in atherosclerosis. *ACS Nano* **2018**, *12*, 9300−9308.[3] *H-ferritin nanocages radio-*

Received: May 5, 2021
Published: August 20, 2021

https://doi.org/10.1021/acs.accounts.1c00267
Acc. Chem. Res. 2021, 54, 3313−3325

国 家 知 识 产 权 局

610000

四川省成都市锦江区东大街下东大街段216号1栋22层2号 成都方圆聿联专利代理事务所（普通合伙）

李鹏(02869713656)

发文日：

2022年06月27日

申请号或专利号：**202210307963.0**　　发文序号：**2022062200900930**

申请人或专利权人：北京理工大学

发明创造名称：一种金单原子葡萄糖氧化纳米酶的制备方法及应用

发 明 专 利 申 请 公 布 及 进 入 实 质 审 查 阶 段 通 知 书

上述专利申请，经初步审查，符合专利法实施细则第44条的规定。根据专利法第34条的规定，该申请在38卷2501期2022年06月21日专利公报上予以公布。

根据申请人提出的实质审查请求，经审查，符合专利法第35条及实施细则第96条的规定，该专利申请进入实质审查阶段。

提示：

1. 根据专利法实施细则第51条第1款的规定，发明专利申请人自收到本通知书之日起3个月内，可以对发明专利申请主动提出修改。

2. 申请人可以访问国家知识产权局政府网站（www.cnipa.gov.cn）,在专利检索栏目中查询公布文本。如果申请人需要纸件申请公布单行本的纸件，可向国家知识产权局请求获取。

3. 申请文件修改格式要求：

对权利要求修改的应当提交相应的权利要求替换项，涉及权利要求引用关系时，则需要将相应权项一起替换补正。如果申请人需要删除部分权项，申请人应该提交整理后连续编号的部分权利要求书。

对说明书修改的应当提交相应的说明书替换段，不得增加和删除段号，仅只能对有修改部分段进行整段替换。如果要增加内容，则只能增加在某一段中；如果需要删除一个整段内容，应该保留该段号，并在此段号后注明：“此段删除”字样。段号以国家知识产权局回传的或公布/授权公告的说明书段号为准。

对说明书附图、摘要、摘要附图修改的应当提交相应的说明书附图、摘要、摘要附图替换页。

同时，申请人应当在补正书或意见陈述书中标明修改涉及的权项、段号、页。

审　查　员：自动审查　　审查部门：专利局初审及流程管理部

联系电话：010-62356655

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路6号　国家知识产权局专利局受理处收

电子申请，应当通过电子专利申请系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

国 家 知 识 产 权 局

100036

北京市海淀区莲花池东路39号西金大厦6层西侧605室 北京品源专利代理有限公司

刘二艳(010-63377266)

发文日：

2022年08月19日

申请号或专利号：**202210811097.9**　　发文序号：**20220816010590 80**

申请人或专利权人： 北京理工大学

发明创造名称： 一种血铅检测方法

发 明 专 利 申 请 初 步 审 查 合 格 通 知 书

上述专利申请，经初步审查，符合专利法实施细则第44条的规定。

申请人于2022 年07月11日提出提前公布声明，经审查，符合专利法实施细则第46条的规定，专利申请进入公布准备程序。

初步审查合格的上述发明专利申请是以：

2022年7月11日提交的说明书摘要；

2022年7月11日提交的权利要求书；

2022年7月11日提交的说明书；

2022年7月11日提交的说明书附图

为基础的。

提示：

1.发明专利申请人可以自申请日起3年内提交实质审查请求书、缴纳实质审查费，申请人期满未提交实质审查请求书或者期满未缴纳或未缴足实质审查费的，该申请被视为撤回。

2. 专利费用可以通过网上缴费、邮局或银行汇款缴纳，也可以到国家知识产权局面缴。

网上缴费：电子申请注册用户可登陆http://cponline.cnipa.gov.cn，并按照相关要求使用网上缴费系统缴纳。

邮局汇款：收款人姓名：国家知识产权局专利局收费处，商户客户号：110000860。

银行汇款：开户银行：中信银行北京知春路支行，户名：国家知识产权局专利局，账号： 7111710182600166032。

汇款时应当准确写明申请号、费用名称（或简称）及分项金额。未写明申请号和费用名称（或简称）的视为未办理缴费手续。

了解更多详细信息及要求，请登陆http://www.cnipa.gov.cn查询。

审 查 员：徐曦　　审查部门：专利审查协作北京中心初步审查部

联系电话：010-53960312

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路6号 国家知识产权局受理处收

电子申请，应当通过电子专利申请系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

国 家 知 识 产 权 局

610000

四川省成都市锦江区东大街下东大街段 216 号 1 栋 22 层 2 号 成都方圆聿联专利代理事务所(普通合伙)

苟铭(02869713656)

发文日：

2023 年 12 月 22 日

申请号或专利号：202311216481.5 **发文序号：**2023122200324080

申请人或专利权人：北京理工大学

发明创造名称：一种人工氢化酶的制备方法及快速产氢工艺

发 明 专 利 申 请 公 布 通 知 书

上述专利申请，经初步审查，符合专利法实施细则第 44 条的规定。根据专利法第 34 条的规定，该申请在 39 卷 5102 期 2023 年 12 月 22 日专利公报上予以公布。

提示：

1.发明专利申请人可以自申请日起 3 年内提交实质审查请求书、缴纳实质审查费，申请人期满未提交实质审查请求书或期满未足额缴纳实质审查费的，该申请被视为撤回。

2.专利费用可以通过网上缴费、银行/邮局汇款、直接向代办处或国家知识产权局专利局缴纳。缴费时应当写明正确的申请号/专利号、费用名称及分项金额，未提供上述信息的视为未办理缴费手续。了解缴费更多详细信息及办理缴费业务，请登录国家知识产权局官方网站。

3.申请人可以访问国家知识产权局政府网站（www.cnipa.gov.cn），在专利检索栏目中查询公布文本。如果申请人需要纸件申请公布单行本的纸件，可向国家知识产权局请求获取。

4.申请文件修改格式要求：

对权利要求修改的应当提交相应的权利要求替换项，涉及权利要求引用关系时，则需要将相应权项一起替换补正。如果申请人需要删除部分权项，申请人应该提交整理后连续编号的部分权利要求书。

对说明书修改的应当提交相应的说明书替换段，不得增加和删除段号，仅只能对有修改部分段进行整段替换。如果要增加内容，则只能增加在某一段中；如果需要删除一个整段内容，应该保留该段号，并在此段号后注明：“此段删除”字样。段号以国家知识产权局回传的或公布/授权公告的说明书段号为准。

对说明书附图修改的应当以图为单位提交相应的替换附图。

对说明书摘要文字部分修改的应当提交相应的替换页。对摘要附图修改的应当重新指定。

同时，申请人应当在补正书或意见陈述书中标明修改涉及的权项、段号、图、页。

国家知识产权局 专利审查业务章 1101081359734

审 查 员：自动审查　　审查部门：初审及流程管理部

联系电话：010-62356655

210305
2022.10

纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路 6 号 国家知识产权局专利局受理处收

电子申请，应当通过专利业务办理系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

国家自然科学基金资助项目批准通知

（包干制项目）

宋宁宁　先生/女士：

根据《国家自然科学基金条例》、相关项目管理办法规定和专家评审意见，国家自然科学基金委员会（以下简称自然科学基金委）决定资助您申请的项目。项目批准号：52202344，项目名称：基于物理-化学协同抗菌机制的碳化硼基纳米酶及其仿生结构设计，资助经费：30.00万元，项目起止年月：2023年01月至 2025年 12月，有关项目的评审意见及修改意见附后。

请您尽快登录科学基金网络信息系统（https://isisn.nsfc.gov.cn），**认真阅读《国家自然科学基金资助项目计划书填报说明》并按要求填写《国家自然科学基金资助项目计划书》（以下简称计划书）**。对于有修改意见的项目，请您按修改意见及时调整计划书相关内容；如您对修改意见有异议，须在电子版计划书报送截止日期前向相关科学处提出。

请您将电子版计划书通过科学基金网络信息系统（https://isisn.nsfc.gov.cn）提交，由依托单位审核后提交至自然科学基金委。自然科学基金委审核未通过者，将退回的电子版计划书修改后再行提交；审核通过者，打印纸质版计划书（一式两份，双面打印）并在项目负责人承诺栏签字，由依托单位在承诺栏加盖依托单位公章，且将申请书纸质签字盖章页订在其中一份计划书之后，一并报送至自然科学基金委项目材料接收工作组。纸质版计划书应当保证与审核通过的电子版计划书内容一致。**自然科学基金委将对申请书纸质签字盖章页进行审核，对存在问题的，允许依托单位进行一次修改或补齐。**

向自然科学基金委提交电子版计划书、报送纸质版计划书并补交申请书纸质签字盖章页截止时间节点如下：

1. **2022年10月8日16点：**提交电子版计划书的截止时间；

2. **2022年10月14日16点：**提交修改后电子版计划书的截止时间；

3. **2022年10月19日：**报送纸质版计划书（一式两份，其中一份包含申请书纸质签字盖章页）的截止时间。

4. **2022年10月28日：**报送修改后的申请书纸质签字盖章页的截止时间。

请按照以上规定及时提交电子版计划书，并报送纸质版计划书和申请书纸质签字盖章页，逾期不报计划书或申请书纸质签字盖章页且未说明理由的，视为自动放弃接受资助；未按要求修改或逾期提交申请书纸质签字盖章页者，将视情况给予暂缓拨付经费等处理。

附件：项目评审意见及修改意见表

国家自然科学基金委员会

2022年9月7日

附件：项目评审意见及修改意见表

项目批准号	52202344	项目负责人	宋宁宁	申请代码1	E0210
项目名称	基于物理-化学协同抗菌机制的碳化硼基纳米酶及其仿生结构设计				
资助类别	青年科学基金项目		亚类说明		
附注说明					
依托单位	北京理工大学				
直接费用	30.00 万元		起止年月	2023年01月 至 2025年12月	

通讯评审意见:

<1>具体评价意见:

一、该申请项目的研究思想或方案是否具有新颖性和独特性？请详细阐述判断理由。

本项目申请人基于前期碳化硼纳米线和双金属纳米酶的研究基础，提出利用力学性能优异的碳化硼纳米线作为物理抗菌骨架，模仿天然纳米抗菌结构设计和组装碳化硼/钴酸镍复合纳米酶，最终获得高活性和高细菌捕获效率兼备的
纳米酶，利用物理-化学协同机制实现高效抗菌。本项目拟深入研究碳化硼基复合纳米酶的合成工艺，解析仿生多级结构对催化活性、细菌捕获能力以及抗菌性能的纳米效应，探索纳米酶与细菌的相互作用过程，研究思想具有较好的新颖性和独特性。

二、请评述申请项目所关注问题的科学价值以及对相关前沿领域的潜在贡献。

面对日趋严重的细菌感染威胁，开发具有新型杀菌机制的纳米抗菌剂并实现高效杀菌是亟待解决的前沿科学问题。针对上述科学问题，申请人受自然界昆虫翅膀等纳米抗菌表面细菌捕获机制的启发，提出构建具有仿生多级结构的新型碳化硼/钴酸镍复合纳米酶，通过模仿天然纳米抗菌结构实现物理-化学协同抗菌，为开发新型高效纳米抗菌剂提供了独特的解决办法。本研究具有较好的科学价值，研究成果有望对本学科前沿领域做出重要贡献。

三、请评述申请人的创新潜力与研究方案的可行性。

申请人具有多学科交叉研究背景和创新潜力，研究方案可行。建议申请人对本项目的相关研究基础进行进一步探索和积累以确保本项目关键科学问题顺利高效解决。

四、其他建议

<2>具体评价意见:

一、该申请项目的研究思想或方案是否具有新颖性和独特性？请详细阐述判断理由。

细菌感染疾病严重威胁着人类健康，针对抗生素和无抗生素纳米抗菌剂杀菌效率不足等问题，申请人提出学习自然界昆虫翅膀等纳米抗菌表面细菌捕获机制，通过构建具有仿生多级结构的新型碳化棚/钴酸镍复合纳米酶，模仿天然纳米抗菌结构实现物理-化学协同抗菌。以生物质为原材料生长的碳化棚基物理抗菌骨架力学性能优异，钴酸镍纳米酶具有双金属活性位点，催化活性高，结合两者的优点，有望获得高活性和高细菌捕获效率兼备的复合纳米酶，实现高效抗菌。该开发纳米抗菌剂的策略具有显著的新颖性和独特性。

二、请评述申请项目所关注问题的科学价值以及对相关前沿领域的潜在贡献。

本项目所关注问题具有非常重要的科学价值和意义，有望推进纳米酶的基础和应用研究。

三、请评述申请人的创新潜力与研究方案的可行性。

申请人在本项目相关研究取得了许多进展，有非常好的基础，创新潜力强，并且研究方案详实，可行性高。

四、其他建议

<3>具体评价意见:

一、该申请项目的研究思想或方案是否具有新颖性和独特性？请详细阐述判断理由。
该项目聚焦开发新型杀菌机制的纳米抗菌剂，提出构建具有仿生结构的复合纳米酶，实现物理-化学协同抗菌，研究思想及方案具有较好的新颖性和独创性。

二、请评述申请项目所关注问题的科学价值以及对相关前沿领域的潜在贡献。
该项目通过模拟自然界生物抗菌纳米表面，设计仿生结构，提高纳米材料捕获细菌的效率并通过机械力抗菌，结合纳米酶的性质，开发新一代纳米抗菌剂，在对抗耐药菌方面具有较高的科学价值。为抗菌治疗提供了一条新的思路。

三、请评述申请人的创新潜力与研究方案的可行性。
申请人结合仿生结构，构建复合纳米酶抗菌剂，通过特殊形貌的表面结构，和纳米酶的催化活性，拓展了基于物理-化学作用协同抗菌的材料设计及机制研究，具有较高的创新潜力。申请人在利用纳米线构筑表面多级结构方面具有丰富的研究经验，其研究团队在纳米酶方面也做了很多工作，都保障了研究方案的可行性。

四、其他建议
无

修改意见：

工程与材料科学部

2022年9月7日

课题编号：2022YFA1205801　　**密　级：公开**

国家重点研发计划
课题任务书

课题名称： 纳米酶构效关系研究及细胞内催化性能精准调控

所属项目： 纳米酶精准调控及用于血液恶性肿瘤诊疗技术研究

所属专项： 纳米前沿

项目牵头承担单位： 中国医学科学院基础医学研究所

课题承担单位： 北京理工大学

课题负责人： 梁敏敏

执行期限： 2023 年 05 月 至 2028 年 04 月

中华人民共和国科学技术部制

2023 年 04 月 27 日

0003YF 2022YFA1205801 2023-04-27 10:42:26

九、课题参加人员基本情况表

填表说明： 1.专业技术职称：A、正高级　B、副高级　C、中级　D、初级　E、其他；
2.投入本课题的全时工作时间（人月）是指在课题实施期间该人总共为课题工作的满月度工作量；累计是指课题组所有人员投入人月之和；
3.课题固定研究人员需填写人员明细；
4.是否有工资性收入：Y、是　N、否；
5.人员分类代码：B、课题负责人　C、项目/课题骨干　D、其他研究人员；
6.工作单位：填写单位全称，其中高校要具体填写到所在院系。

序号	姓名	性别	出生日期	证件类型	证件号码	专业技术职称	职务	最高学位	专业	投入本课题的全时工作时间（人月）	人员分类代码	在课题中分担的任务	是否有工资性收入	工作单位
1	梁敏敏	女	1978-08-30	身份证	37011219780830774X	正高级	无	博士	纳米生物学	40	课题负责人	课题负责人，纳米酶构效研究	是	北京理工大学材料学院
2	阎锡蕴	女	1957-02-25	身份证	110104195702252608	正高级	主任	博士	免疫生物学	30	课题骨干	纳米酶的设计	是	中国科学院生物物理研究所
3	宋宁宁	女	1988-03-03	身份证	230522198803032001	副高级	无	博士	纳米生物学	40	课题骨干	纳米酶的设计、制备	是	北京理工大学材料学院
4	郭占君	男	1989-09-09	身份证	140227198909090035	中级	无	博士	纳米生物学	40	课题骨干	纳米酶酶活测试	是	北京理工大学材料学院
5	张建林	男	1989-06-07	身份证	130125198906073539	中级	无	博士	细胞生物学	50	课题骨干	纳米酶对肿瘤微环境的调节	是	北京理工大学材料学院
6	蒋冰	女	1992-06-16	身份证	410225199206169887	中级	无	博士	纳米生物学	50	课题骨干	纳米酶对细胞微环境的调节	是	北京理工大学材料学院
7	孟祥芹	女	1993-11-26	身份证	37132519931126752X	其他	无	学士	生物化学	24	课题骨干	纳米酶的生	是	中国科学院生物物理研究

北京理工大学学生平时成绩登记表

开课学期	2022-2023-2	课程	材料力学	教师	宋宁宁	班级	09112101,09312101,09422101
选课课号	(2022-2023-2)-100090007-03	教师单位	材料学院	上课时间地点	9-16周 星期三 3-4节 文萃楼I405,9-16周 星期五 8-9节 文萃楼I405		
调课信息							

序号	学号	姓名	专业	行政班	学生类别（港澳台、留学生）	理论成绩												总评成绩
						平时成绩								考试成绩		理论总评		
													折合	成绩	折合			
1	1120210050	王一凡	高分子材料与工程	09312101														
2	1120210286	董守顺	高分子材料与工程	09312101														
3	1120210375	滕梓祥	新能源材料与器件	09422101														
4	1120210397	沐润	高分子材料与工程	09312101														
5	1120210580	罗珊珊	高分子材料与工程	09312101														
6	1120211068	贺逸飞	材料化学	09112101														
7	1120211272	王木菁	高分子材料与工程	09312101														
8	1120211445	王凯	高分子材料与工程	09312101														
9	1120211460	赵艺哲	材料化学	09112101														
10	1120211476	谭博蔚	新能源材料与器件	09422101														
11	1120211997	陈睿思	材料化学	09112101														
12	1120212038	梁可欣	新能源材料与器件	09422101														
13	1120212042	柏航	新能源材料与器件	09422101														
14	1120212123	刘子平	高分子材料与工程	09312101														
15	1120212130	黄惟恺	高分子材料与工程	09312101														
16	1120212279	蔡大源	高分子材料与工程	09312101														
17	1120212637	赵欣	高分子材料与工程	09312101														
18	1120212647	郁小雯	材料化学	09112101														
19	1120212730	李俊仪	高分子材料与工程	09312101														
20	1120212905	高鑫康	新能源材料与器件	09422101														
21	1120212959	罗景元	新能源材料与器件	09422101														
22	1120213074	吕泽灏	材料化学	09112101														
23	1120213211	马昊	新能源材料与器件	09422101														
24	1120213664	王子毅	高分子材料与工程	09312101														
25	1120213675	毕巴尔斯·叶尔兰	高分子材料与工程	09312101														

成绩总结

应考人数	缺考人数	100-90分	89-80分	79-70分	69-60分	59分及其以下	平均分

北京理工大学学生平时成绩登记表

开课学期	2022-2023-2	课程	材料力学	教师	宋宁宁	班级	09112101,09312101,09422101
选课课号	(2022-2023-2)-100090007-03	教师单位	材料学院	上课时间地点	9-16周 星期三 3-4节 文萃楼I405,9-16周 星期五 8-9节 文萃楼I405		
调课信息							

序号	学号	姓名	专业	行政班	学生类别（港澳台、留学生）	理论成绩												总评成绩
						平时成绩								考试成绩		理论总评		
													折合	成绩	折合			
26	1120213682	阿克旦·吐尔逊	高分子材料与工程	09312101														

成绩总结

应考人数	缺考人数	100-90分	89-80分	79-70分	69-60分	59分及其以下	平均分

北京理工大学学生平时成绩登记表

开课学期	2023-2024-2	课程	材料力学	教师	宋宁宁	班级	09022202,09022203
选课课号	(2023-2024-2)-100090007-02	教师单位	材料学院	上课时间地点	9-16周 星期三 3-4节 文萃楼I302,9-16周 星期五 3-4节 文萃楼I302		
调课信息							

序号	学号	姓名	专业	行政班	学生类别（港澳台、留学生）	理论成绩													总评成绩
						平时成绩								考试成绩		理论总评			
													折合	成绩	折合				
1	1120213539	杨佳艺	先进材料类	09022203															
2	1120213678	丹碧苏荣	先进材料类	09022202															
3	1120220212	张永基	先进材料类	09022202															
4	1120220223	郭梓菲	先进材料类	09022203															
5	1120220264	常建峰	先进材料类	09022202															
6	1120220267	蔡晋	先进材料类	09022203															
7	1120220279	李宇新	先进材料类	09022203															
8	1120220288	刘思辰	先进材料类	09022202															
9	1120220375	申雅劼	先进材料类	09022202															
10	1120220416	赵琦炜	先进材料类	09022203															
11	1120220440	柴天尧	先进材料类	09022203															
12	1120220441	袁鹏飞	先进材料类	09022203															
13	1120220451	刘咏	先进材料类	09022202															
14	1120220847	任俊彤	先进材料类	09022203															
15	1120220873	吉海灵	先进材料类	09022203															
16	1120220881	李佳骏	先进材料类	09022203															
17	1120220885	杨超祥	先进材料类	09022202															
18	1120221047	刘美仑	先进材料类	09022202															
19	1120221066	田荣智	先进材料类	09022203															
20	1120221254	王烨杭	先进材料类	09022202															
21	1120221351	张绳棉	先进材料类	09022203															
22	1120221367	刘境	先进材料类	09022203															
23	1120221371	张佳琪	先进材料类	09022203															
24	1120221373	姬筱雅	先进材料类	09022202															
25	1120221475	魏路野	先进材料类	09022202															
26	1120221493	郭昊	先进材料类	09022203															

成绩总结

应考人数	缺考人数	100-90分	89-80分	79-70分	69-60分	59分及其以下	平均分

北京理工大学学生平时成绩登记表

开课学期	2023-2024-2	课程	材料力学	教师	宋宁宁	班级	09022202,09022203
选课课号	(2023-2024-2)-100090007-02	教师单位	材料学院	上课时间地点	9-16周 星期三 3-4节 文萃楼I302,9-16周 星期五 3-4节 文萃楼I302		
调课信息							

序号	学号	姓名	专业	行政班	学生类别（港澳台、留学生）	理论成绩												总评成绩
						平时成绩								考试成绩		理论总评		
													折合	成绩	折合			
27	1120221499	杨允行	先进材料类	09022202														
28	1120221511	海若涵	先进材料类	09022203														
29	1120221864	陈良轩	先进材料类	09022202														
30	1120222056	申丁	先进材料类	09022202														
31	1120222188	赵浦	先进材料类	09022203														
32	1120222534	唐高智	先进材料类	09022202														
33	1120222560	向俊霖	先进材料类	09022202														
34	1120222683	扎西顿珠	先进材料类	09022203														
35	1120222691	杨鑫宇	先进材料类	09022202														
36	1120222719	蓝宇森	先进材料类	09022202														
37	1120222734	钟小灵	先进材料类	09022202														
38	1120222742	高东坡	先进材料类	09022202														
39	1120222992	段赛坤	先进材料类	09022203														
40	1120222999	胡良宇	先进材料类	09022202														
41	1120223052	甄诚	先进材料类	09022203														
42	1120223085	童一泽	先进材料类	09022203														
43	1120223091	张震霆	先进材料类	09022202														
44	1120223290	侯艺清	先进材料类	09022203														
45	1120223413	郑立文	先进材料类	09022202														
46	1120223414	狄楷棋	先进材料类	09022202														

成绩总结

应考人数	缺考人数	100-90分	89-80分	79-70分	69-60分	59分及其以下	平均分

0903001 系统工程学（16学时，宋宁宁）					
	周一	周二	周三	周四	周五
第一大节（8:00-9:35）					
第二大节（9:55-12:20）		只上3，4两小节 研-209（w12-15）			
第三大节（13:20-14:55）					研-209（w12-15）
第四大节（15:15-17:40）					
第五大节（18:30-20:55）					

学生名单	
含能专项	
3220221265	曾鑫龙
3220221266	陈超
3220221267	单国翔
3220221268	丁宏鑫
3220221269	杜欣雨
3220221270	付泓迪
3220221271	龚政
3220221272	康学猛
3220221273	马睿祥
3220221274	孙文才
3220221275	滕冲
3220221276	万学谦
3220221277	王静
3220221278	王同斌
3220221279	王孝帅
3220221280	魏巍
3220221281	徐俊杰
3220221282	张蕊
3220221283	张星
3220221284	邹晓艺

北京理工大学2023-2024学年 第二学期研究生课程学生选课名单

教学班	0900100 生物医用材料技术(生物医用材料技术01)				任课教师	宋宁宁[辅讲],郭占君[辅讲]	
上课时间地点	11-14周 星期四[3-5节]研楼509;11-12,14-15周 星期二[8-10节]研楼509;13周 星期二[8-10节]5号教学楼B121实验室;15周 星期四[3-5节]5号教学楼B121实验室;16周 星期二[8-9节]5号教学楼B121实验室						
序号	学号	姓名	培养层次	学生分类	学生类别	学院	专业
1	3120231385	范舜骅	硕士	全日制	统招统分研究生	生命学院	071000 生物学
2	3220231460	张宇轩	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
3	3220231462	朱永戚	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
4	3220231465	王梓琰	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
5	3220231467	李兴康	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
6	3220231469	李印琪	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
7	3220231471	成功	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
8	3220231472	李思辰	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
9	3220231474	马浩然	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
10	3220231479	姜浩	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
11	3220231481	李苒	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
12	3220231507	逯泽萱	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
13	3220231508	赵明珠	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
14	3220231512	侯宇澄	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
15	3220231532	王思卿	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
16	3220231536	牛亚芳	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
17	3220231542	杨开杰	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
18	3220231546	庞雪	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
19	3220231547	尚菡语	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
20	3220231548	苏春月	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
21	3220231556	王元昊	硕士	全日制	统招统分研究生	材料学院	085601 材料工程

序号	学号	姓名	培养层次	学生分类	学生类别	学院	专业
22	3220231581	吴英琳	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
23	3220231583	吴晓妍	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
24	3220231585	常浩楠	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
25	3220231591	李源博	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
26	3220231594	欧阳平慧	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
27	3220231596	余芷娴	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
28	3220231597	郑秀洁	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
29	3220231599	张佳蒙	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
30	3220231600	吕子涵	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
31	3220231603	王子彤	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
32	3220231619	杜慧杰	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
33	3220231622	徐硕	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
34	3220231623	李怡聃	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
35	3220231625	陈添德	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
36	3220231628	朱恒辉	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
37	3220231631	叶炳光	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
38	3220231632	李志强	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
39	3220231641	阮玉超	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
40	3220231645	高藩	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
41	3220231648	罗文广	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
42	3220231651	李静文	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
43	3220231652	韦心媛	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
44	3220231653	陈力	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
45	3220231655	钱子进	硕士	全日制	统招统分研究生	材料学院	085601 材料工程

序号	学号	姓名	培养层次	学生分类	学生类别	学院	专业
46	3220231656	周驰东	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
47	3220231660	孙瑞安	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
48	3220231662	李泉	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
49	3220231672	袁玥	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
50	3220232599	李秋艳	硕士	全日制	统招统分研究生	医学技术学院	085601 材料工程
51	3220232627	曹泽凝	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
52	3220232630	赵琨瑀	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
53	3220232635	赵旖暄	硕士	全日制	统招统分研究生	材料学院	085601 材料工程
54	3220232673	王艺轩	硕士	全日制	统招统分研究生	先进结构技术研究院	085601 材料工程

Hybrid Nanozymes: From Concept to Biomedical Applications

- **Print Special Issue Flyer**
- **Special Issue Editors**
- **Special Issue Information**
- **Keywords**
- **Published Papers**

A special issue of ***Catalysts*** (ISSN 2073-4344). This special issue belongs to the section "**Biocatalysis**".

Special Issue Editor

Prof. Dr. Ningning Song **E-Mail** **Website**
Guest Editor
Experimental Center of Advanced Materials, School of Materials Science & Engineering, Beijing Institute of Technology, Beijing 100081, China
Interests: carbon-based nanozymes; nanocomposites; nanomanufacturing, nanostructures; biosensors; antibacterial

Special Issue Information

Dear Colleagues,

Nanozymes are an array of novel nanomaterials with catalytic activity and enzymatic reaction kinetics. Since their discovery, their remarkable properties have attracted attention. Compared with natural enzymes, they possess many advantages, such as inherent nanomaterial characteristics, a high catalytic stability, a low cost, feasible mass production, and robustness to harsh environments. At present, the major challenge in the practical implementation of nanozymes resides in their limited types and poor substrate selectivity; therefore, intensive efforts have been devoted to the rational design and engineering of hybrid nanozymes. For example, the catalytic performance of nanozymes can be modified by adjusting their size, shape, composition, and structure; a multifunctional catalytic system can be obtained through hierarchical structure design and and/or multi-component fabrication. Coupling with biological molecules can improve biocompatibility and achieve novel properties.

In this Special Issue, we would like to collect publications describing the concepts, catalytic mechanisms, and applications of hybrid nanozymes with a hierarchical structure and/or multiple components.

Submit your paper and select the Journal “Catalysts” and the Special Issue “Hybrid Nanozymes: From Concept to Biomedical Applications” via: **MDPI submission system**. Please contact the Guest Editor or the journal editor (cicy.chen@mdpi.com) for any queries. Our papers will be published on a rolling basis and we will be pleased to receive your submission once you have finished it.

Prof. Dr. Ningning Song
Guest Editor

国家纳米科学中心

第九届中国国际纳米科学技术会议（ChinaNANO 2023）

会议通知

由国家纳米科学中心主办的“第九届中国国际纳米科学技术会议（***ChinaNANO* 2023**）”将于 2023 年 8 月 26-28 日在北京国际会议中心召开。在科技部、教育部、基金委、中国科学院、中国科协的大力支持下，已经成功举办了八次会议，***ChinaNANO*** 系列会议已经发展成为纳米科学技术领域的品牌会议，成为全球从事纳米领域的科技工作者进行学术与技术交流合作的重要平台。本届 ***ChinaNANO* 2023** 大会邀请来自国内外 500 多名著名专家学者为本次大会呈现精彩的学术报告。热忱欢迎海内外学术同仁踊跃参加这次学术盛会，交流分享纳米科学技术领域的近年来的科研成和发展趋势。

一、会议时间与地点

会议时间：2023 年 8 月 26-28 日（8 月 25 日报到）

会议地点：北京国际会议中心

二、会议注册费

国内代表	6 月 30 日前	6 月 30 日后
正式代表	RMB 2500	RMB 3000
学生	RMB 1800	RMB 2300

备注：1、会议注册费采取线上缴费或者对公汇款的方式收取；对公账户信息如下：

名称：国家纳米科学中心

开户行：建设银行北京中关村分行

账号：11001007300059261021

2、发票由国家纳米科学中心开具。

3、会期期间食宿自理。

三、联系方式

大会秘书处：chinananano@nanoctr.cn

第九届中国国际纳米科学技术会议组委会

国家纳米科学中心（代章）

2023 年 5 月 26 日

中关村汇智抗菌新材料产业技术创新联盟

Chinese Industry Association for Antimicrobial Materials & Products

2023（第 5 届）抗菌科学与技术论坛会议通知

：

2023(第5届)抗菌科学与技术论坛**由中关村汇智抗菌新材料产业技术创新联盟、东北大学和中国科学院金属研究所共同主办，**于 2023 年 8 月 9 日-11 日在沈阳市举行。

抗菌科学与技术论坛自 2012 年创立，两年一届，是抗菌领域最具知名度和影响力的学术大会。本次大会以“抗菌科学引领生物安全”为主题，通过大会报告、分会场、特色论坛、墙报展示、论文摘要集等多种形式展示最新抗菌科学和研究，并以现场展位形式介绍最新抗菌技术、产品、仪器和设备等，以增进国内外抗菌学术交流，促进抗菌科学创新与发展。欢迎国内外从事抗菌相关科学研究、技术开发、产品制造、性能评价等专家、学者、工程技术人员、在校学生踊跃投稿，积极参会。

一．时间地点

时间：2023 年 8 月 9 日-11 日（9 日报到）

地点：辽宁省沈阳市皇朝万鑫酒店（沈阳市和平区青年大街 390 号）

二、主办单位

中关村汇智抗菌新材料产业技术创新联盟

东北大学

中国科学院金属研究所

三、承办单位

北京云记科技有限公司

四．大会日程

8 月 09 日	10:00-22:00	大会报到
	16:00-20:00	墙报张贴、展位布置
8 月 10 日	08:30-09:20	开幕式
	09:20-12:00	大会报告
	12:00-13:30	墙报展讲
	13:30-18:00	分会场
8 月 11 日	08:30-12:00	分会场
	13:30-17:30	分会场
	17:30-18:00	大会闭幕暨颁奖仪式

五．大会注册

本次会议已经开通在线报名功能，请扫描下面二维码进行会议注册报名。

（一）会议注册费

费用标准 / 参会类型	优惠注册费	标准注册费
	2023 年 6 月 30 日前	2023 年 6 月 30 日后
普通代表	2000 元/人	2400 元/人
CIAA 会员（个人或团体）	1600 元/人	2000 元/人
学生（凭学生证）	1200 元/人	1600 元/人

备注：1、为使您享受缴费优惠，请会前缴纳注册费。
2、交通、住宿费用自理。

（二）请将会议注册费汇款至大会指定账号：

户　名：北京云记科技有限公司

账　号：11050161510009100115

开户行：中国建设银行北京北太平庄支行

备注：1、汇款后请将汇款回执及开票信息发送至 ciaa2001@126.com。
2、由北京云记科技有限公司统一开具增值税普通发票。

（三）会议住宿

大会协议酒店的房间预订受理截止时间为 **2023 年 7 月 10 日**，在此之后不再受理房间预订。住宿费在办理入住时由酒店方收取，住宿发票由酒店开具。

房间信息 / 酒店名称	豪华大床房（间）		豪华双床房（间）	
	单早	双早	单早	双早
皇朝万鑫酒店	450 元/间	500 元/间	450 元/间	500 元/间

六．大会联络

有关大会相关事项，请联络大会秘书处：

曾雅晶（ciaa2001@126.com，15652838082）

王　贺（ciaa2001@126.com，13867473919）

中关村汇智抗菌新材料产业技术创新联盟

二〇二三年七月六日

ASTF
第五届抗菌科学与技术论坛

编号：ASTF2023-S02-O-08

报告人证书

CERTIFICATE OF HONOR

尊敬的 宋宁宁 教授/研究员：

感谢您出席2023（第5届）抗菌科学与技术论坛，并以 Bioinspired hierarchical self-assembled nanozyme for efficient antibacterial treatment 为主题在无机抗菌材料分会场进行报告。特发此证。

中关村汇智抗菌新材料产业技术创新联盟

二零二三年八月

荣誉证书

HONORARY CREDENTIAL

宋宁宁：

您在“崇廉尚洁明纪法，勤廉并重担使命” 主题海报设计比赛中荣获个人二等奖。

特发此证，以资鼓励。

北京理工大学材料学院党委

2023 年 11 月

荣誉证书

HONORARY CREDENTIAL

宋宁宁同志：

您在“廉洁文化强基固本，崇廉拒腐笃行不怠”党风廉政知识竞赛活动中荣获个人**一等奖**。

特发此证，以资鼓励。

北京理工大学材料学院党委

二〇二二年七月