



ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

www.elsevier.com/locate/jes**JES**
JOURNAL OF
ENVIRONMENTAL
SCIENCES
www.jesc.ac.cn

Research Article

Hierarchical V₂O₃ spiny hollow nanosphere for efficient adsorption of precious metal ions in complicated matrices

Q1
Q2
Weiyuan Liu¹, Wentao Wang^{2,*}, Jiahui Zhou¹, Hongxia Deng¹,
Shanshan Tong^{1,*}

¹College of Chemistry and Pharmacy, Northwest A&F University, Yangling 712100, China²Department of Radiochemistry, China Institute of Atomic Energy, Beijing 102413, China

ARTICLE INFO

Article history:

Received 26 May 2024

Revised 9 August 2024

Accepted 12 August 2024

Available online xxx

Keyword:

Hollow V₂O₃ nanosphere

Adsorption

Au(III)

Ag(I)

Pd(II)

Pt(IV)

ABSTRACT

Treatment of precious metals in electronic waste has attracted tremendous attention and is essential for both environmental protection and resource sustainable development. In this study, a novel adsorbent for precious metal ions, V₂O₃ spiny hollow nanospheres (p-V₂O₃ SHN), was synthesized through a one-step hydrothermal-assisted methodology for the adsorption of Au(III), Ag(I), Pd(II), and Pt(IV) from the leaching solution of electronic waste. The results reveal that the p-V₂O₃ SHN hierarchy was successfully constructed with a hollow structure and dense spiny morphology. The prepared p-V₂O₃ SHN can effectively remove precious metal ions such as Au(III), Ag(I), Pd(II), and Pt(IV), with the selective capture order being Au(III) > Ag(I) > Pt(IV) > Pd(II) > other metal ions. This superior adsorption capability can be attributed to the multi-diffusible, intermingled composition, and numerous active sites decorating the p-V₂O₃ SHN hierarchy, facilitating the uptake of Au(III), Ag(I), Pd(II), and Pt(IV) ions from electronic waste. The Langmuir model provided a better fit for the uptake process, revealing maximum uptake capacities of 833.33 mg/g for Au(III), 370.37 mg/g for Ag(I), 77.51 mg/g for Pd(II), and 42.01 mg/g for Pt(IV) on p-V₂O₃ SHN. Remarkably, p-V₂O₃ SHN exhibited a robust affinity for the adsorbate due to the presence of surface defects and reduction. The new p-V₂O₃ SHN also demonstrated good reusability for three sorption cycles, highlighting its potential for electronic waste treatment. Due to its facile synthesis and excellent efficiency, hierarchical p-V₂O₃ SHN presents itself as a promising candidate for the selective uptake of Au(III), Ag(I), Pt(IV), and Pd(II) from electronic waste.

© 2024 The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. Published by Elsevier B.V.

* Corresponding authors.

E-mails: tongss@nwsuaf.edu.cn (W. Wang), wentaowang001@163.com (S. Tong).

<https://doi.org/10.1016/j.jes.2024.08.013>

1001-0742/© 2024 The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. Published by Elsevier B.V.