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黄铁矿基材料在处理重金属废水中的进展与挑战

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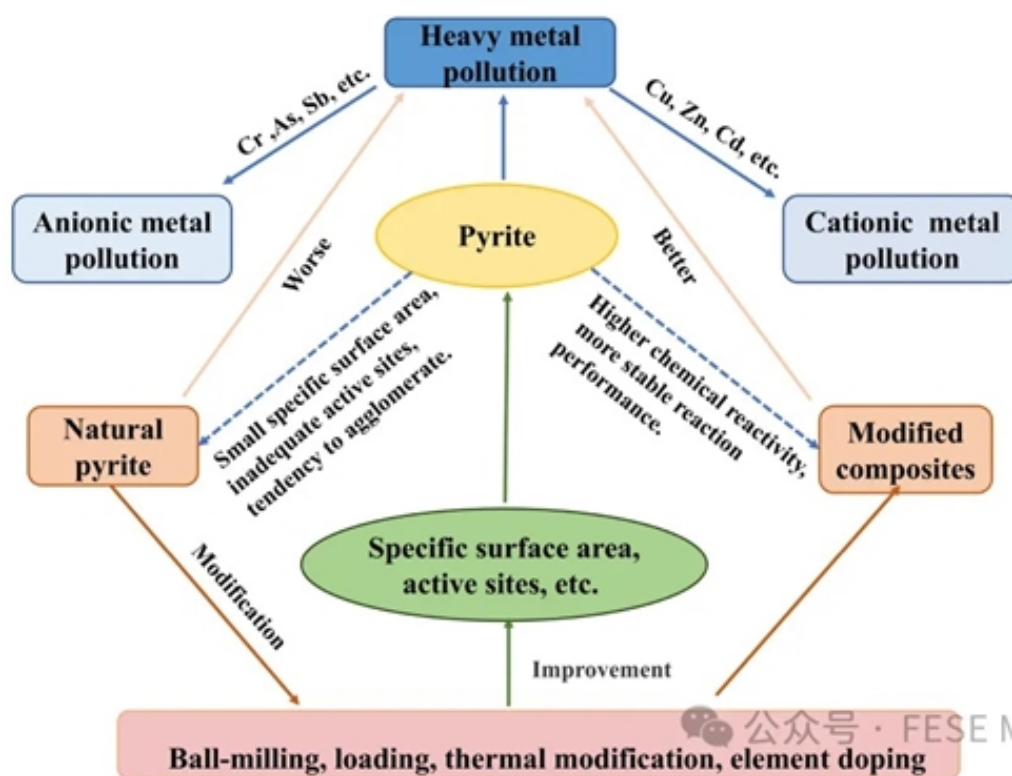
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摘要图

水体中的重金属污染主要由人类活动造成，目前已成为我国备受关注的重大问题。黄铁矿因其出色的吸附和氧化还原性能、成本低廉及环境友好性等特点，在处理重金属废水方面受到广泛关注。然而天然黄铁矿存在比表面积小、活性位点不足、易团聚等固有缺陷，限制了其去除重金属离子的效果。为了解决这些缺陷并优化黄铁矿的实际应用性能，人们开发出了多种改性策略。本文通过对内在机理的对比，系统地综述了黄铁矿对不同重金属离子的氧化、还原及吸附能力，探讨了黄铁矿的改性策略及其对应的强化机制。最后，本文系统回顾了黄铁矿及其改性复合材料在重金属废水处理方面的应用现状及未来研究方向。总体而言，本研究从理论认识、实际应用及未来改性策略等方面系统综述了黄铁矿基材料在重金属去除领域的研究进展。

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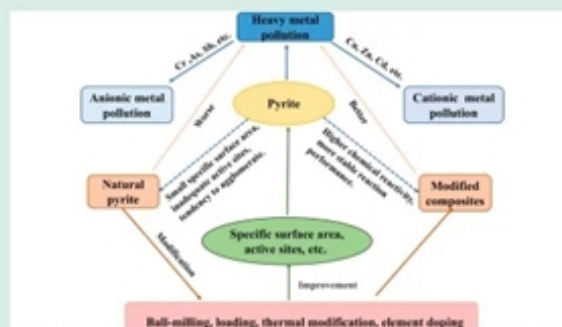
Pyrite-based materials for heavy metals wastewater remediation: progress and challenges

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HIGHLIGHTS

- The mechanisms underlying heavy metal removal by pyrite were explored.
- Pyrite modification methods and their enhancement mechanisms were investigated.
- The applications and performance of pyrite were comprehensively summarized.
- Future research directions for pyrite-based materials were critically identified.



ABSTRACT: The heavy metal pollution in water, largely driven by human activities, has become a significant concern in China. Pyrite has gained attention for treating heavy metal wastewater due to its excellent adsorptive and redox properties, affordability, and environmental compatibility. However, the inherent limitations of natural pyrite, such as its small specific surface area, inadequate active sites, and tendency to agglomerate, hinder its effectiveness in removing heavy metal ions. To address these shortcomings and optimize pyrite's performance in practical applications, various modification strategies have been developed. In this paper, the oxidation, reduction, and adsorption capabilities of pyrite with respect to different heavy metal ions have been systematically reviewed by the comparison of the underlying mechanisms. We also discussed pyrite modification strategies and their corresponding enhancement mechanisms. Finally, the paper systematically reviews the current application status and future research trends of pyrite and its modified composites in heavy metal wastewater treatment. Basically, this work provides a systematic review on pyrite-based materials for heavy metal removal, from theoretical insights to practical applications and future modification strategies.

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#Kaixuan Zheng and Fuli Li are co-first authors of the article.

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