

# Research Highlights

[Vol. 64]

## Biogenic Iron Sulfide Nanoparticles Enable Electron Uptake in Bacteria

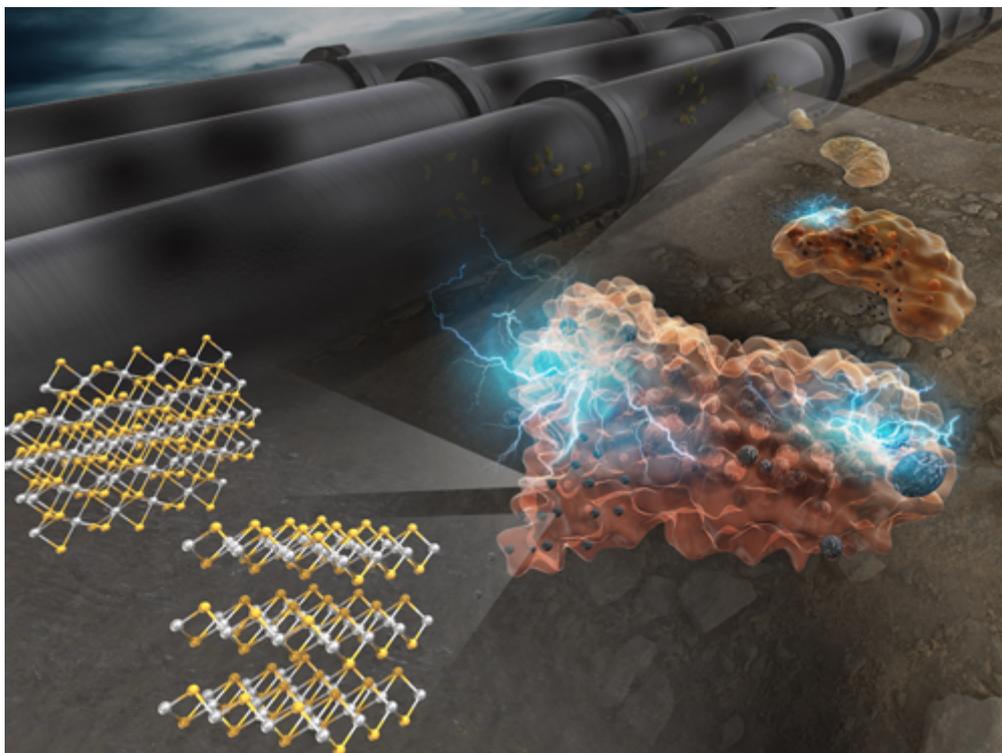
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A MANA team has identified the mechanism underlying the synthesis of long, electrically conductive pathways via iron sulfide (FeS) nanoparticles (NPs) in bacteria. This has implications in the development of new ways to inhibit microbial iron corrosion, as well as understanding the pathways of organic matter preservation in marine systems.



Many bacterial species are capable of biosynthesizing NPs. These nanoparticles are ubiquitous in nature, and the formation of FeS minerals is driven by the reaction between ferrous compounds and the free sulfide predominantly produced by sulfate-reducing bacteria (SRB), which produce 97% of the sulfide on earth through their metabolic activity.

Biosynthesized NPs facilitate microbial energy production in various environments, including extreme conditions. However, until now little research has been done on the biological role of FeS NPs in such bacteria.

The MANA team identified FeS NPs with electrically conductive crystal phase associated with cellular membrane of the SRB *D. vulgaris*. They showed that the conductive NPs can function as an electron conduit, enabling bacteria to utilize solid-state electron donors via direct electron uptake.

This is the first report of SRB utilizing solid-state electron donors via direct extracellular electron uptake. This strategy does not require organic electron donors and would therefore be especially

effective in sediments containing highly reductive minerals.

Since microbial sulfate reduction is the most important pathway for organic matter remineralization in marine sediments, the biogeochemical cycles of iron and sulfur facilitated by the metabolic activity of SRB are intimately linked to the carbon cycle.

This research provides new insights into the interplay and evolution of biogeochemical cycles including iron, sulfur and carbon. In addition, clarifying the mechanism behind the synthesis of long, electrically conductive pathways via FeS NPs could lead to effective strategies for inhibiting microbial iron corrosion.

This research was carried out by [Akihiro Okamoto](#)(Independent Scientist) and his collaborators.

## Reference

“Biogenic Iron Sulfide Nanoparticles to Enable Extracellular Electron Uptake in Sulfate-Reducing Bacteria”

Xiao Deng, Naoshi Dohmae, Anna H. Kaksonen and [Akihiro Okamoto](#)

Journal: Angew Chem Int Ed Engl. 2020 Apr 6;59(15):5995-5999. [25 December 2019]

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(Press release on this research)

“Formation of Black Rust Accelerates Bacterial Iron Corrosion” (14 February 2020)

[https://www.nims.go.jp/mana/news\\_room/press/2020021401.html](https://www.nims.go.jp/mana/news_room/press/2020021401.html)

(MANA E-BULLETIN)

<https://www.nims.go.jp/mana/ebulletin/>

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