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Opinion

Hyperaccumulating Plants: An Emerging Avenue in Electrocatalytic Water Splitting

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Opinion

The world is at a crossroads when it comes to sustainable energy production. As we grapple with the urgent need to transition away from fossil fuels, innovative solutions are emerging. Among these, hyperaccumulation plants can be promising candidates for electrocatalytic applications. These remarkable plants, with their ability to absorb and store high concentrations of heavy metals from the soil [1], are not just green marvels of nature; they are also key players in electrocatalytic water splitting.

Electrocatalytic water splitting, the process of using electricity to break water molecules into hydrogen and oxygen, holds immense promise for the renewable energy landscape [2,3]. Hydrogen, when produced through this method, serves as a clean fuel that emits only water vapor when consumed [4]. However, the efficiency and cost-effectiveness of this process have been limiting factors until now.

These botanical wonders possess a unique ability to accumulate metals like nickel, cobalt, and iron in their tissues [5]. This characteristic, known as hyperaccumulation, has traditionally fascinated botanists and ecologists for its role in phytoremediation (the process of using plants to clean up contaminated environments). But now, their potential in electrocatalytic water splitting is taking center stage [6]. The metals these plants accumulate are precisely the catalysts needed for efficient water splitting. Nickel, for instance, is a crucial component of the hydrogen-evolving reaction, while cobalt and iron are essential for the oxygen-evolving reaction [7-9]. By harnessing these naturally accumulated metals, researchers are unlocking a pathway to more efficient and sustainable hydrogen production.

One of the most compelling aspects of this approach is its environmental friendliness. Unlike conventional methods of obtaining these metals, such as mining and extraction, harvesting them from hyperaccumulation plants is inherently eco-friendly [10]. It reduces the need for destructive mining practices, minimizing the associated environmental impact and carbon footprint. Moreover, hyperaccumulation plants offer a renewable resource for these critical metals [10]. Instead of relying on limited mineral deposits, we can cultivate these plants in a controlled environment, ensuring a sustainable and continuous supply of electrocatalysts for water splitting.

However, challenges remain. Scaling up the production of hyperaccumulation plants for widespread use in electrocatalysis will require concerted efforts. Researchers need to optimize plant growth conditions, increase metal accumulation rates, and develop efficient methods for metal extraction. Additionally, ensuring that the cultivation of these plants is done responsibly, without adverse effects on ecosystems, is paramount.

In conclusion, hyperaccumulation plants represent a promising frontier in the realm of electrocatalytic water splitting. Their natural ability to accumulate heavy metals offers a sustainable, environmentally friendly solution to the challenges of hydrogen production. As we strive towards a greener future, let us not overlook these botanical allies. With further research and investment, hyperaccumulation plants could well be the green electrocatalysts that power the hydrogen economy of tomorrow.

References

1. Skuza L, Szućko-Kociuba I, Filip E, Bożek I (2022) Natural molecular mechanisms of plant hyperaccumulation and hypertolerance towards heavy metals. International Journal of Molecular Sciences 23(16): 9335.
2. Farsi H, Irandoost E, Barekati NS, Moghiminia S, Hosseini S, et al. (2023) Nanostructured MnWO4 as a bifunctional electrocatalyst for water splitting. ECS Journal of Solid-State Science and Technology 12: 083007.
3. Irandoost E, Farsi H, Farrokhi A, Barekati NS, Z. Li (2022) Environmentally benign synthesis of copper benzenetricarboxylic acid mof as an electrocatalyst for overall water splitting and CO_2 reduction. ECS Advances 1: 020501.
4. Irandoost E, Barekati NS, Farsi H, Farrokhi A, Horvath G, et al. (2023) Cobalt-organic framework as a bi-functional electrocatalyst for renewable hydrogen production by electrochemical water splitting. Applications in Energy and Combustion Science 17: 100240.
5. Reeves RD, Baker AJM, Jaffré T, Erskine PD, Echevarria G, et al. (2018) A global database for plants that hyperaccumulate metal and metalloid trace elements. New Phytologist 218: 407-411.
6. Cao X, Huang Y, Tang C, Wang J, Jonson D, et al. (2020) Preliminary study on the electrocatalytic performance of an iron biochar catalyst prepared from iron-enriched plants. Journal of Environmental Sciences 88: 81-89.
7. Huo L, Jin C, Jiang K, Bao Q, Hu Z, et al. (2022) Applications of nickel-based electrocatalysts for hydrogen evolution reaction. Advanced Energy and Sustainability Research 3: 2100189.
8. Irandoost E, Barekati NS, Farsi H, Farrokhi A, Moghiminia S (2023) Ultrathin two-dimensional cobalt-organic framework nanosheets as an effective electrocatalyst for overall water splitting under alkaline conditions. Electrochimica Acta 466: 143075.
9. Moghiminia S, Farsi H, Zubkov T, Hosseini S, Behforouz M, et al. (2023) Revealing electronic structure of nanostructured cobalt titanate via a combination of optical and electrochemical approaches toward water splitting and CO_2 reduction. Journal of Chemical Technology & Biotechnology 98: 2257-2265.
10. Bhat SA, Bashir O, Ul Haq SA, Amin T, Rafiq A, et al. (2022) Phytoremediation of heavy metals in soil and water: An eco-friendly, sustainable and multidisciplinary approach. Chemosphere 303: 134788.

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