

Efficient water splitting via a flexible solar-powered Hybrid thermochemical-Sulphur dioxide depolarized Electrolysis Cycle

Bibliometric analysis of SO₂ Depolarized Electrolyser

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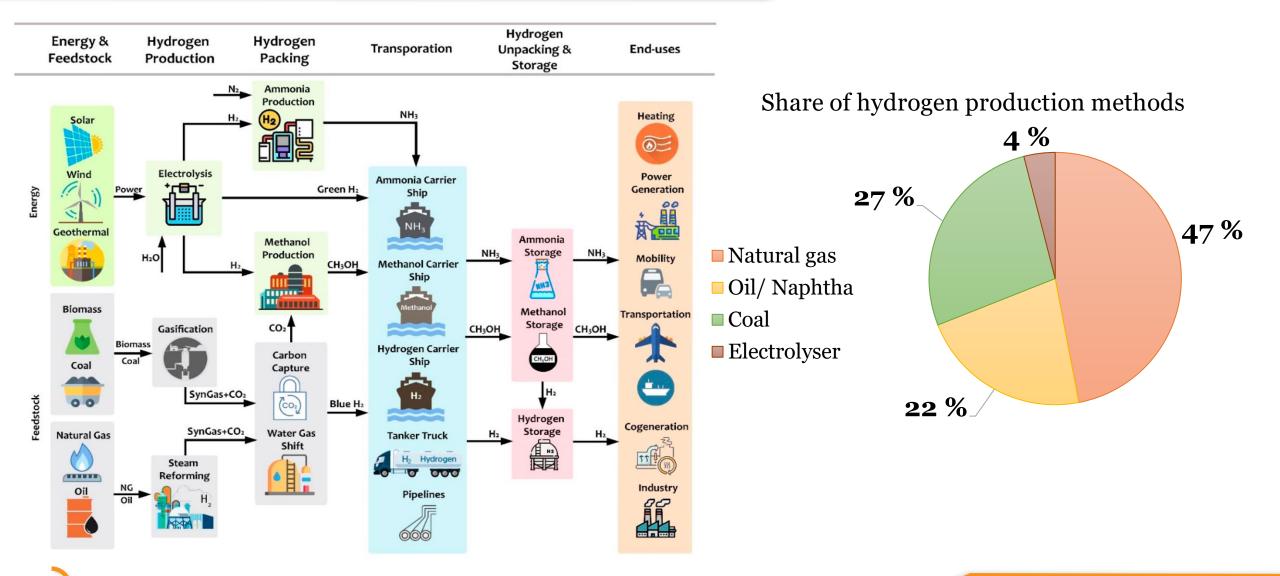






Need for a new electrolysis method?





Source: Salimi, M., M. Hosseinpour, and T. N. Borhani, The Role of Clean Hydrogen Value Chain in a Successful Energy Transition of Japan. Energies, 2022. 15(16): p. 6064.

SDE vs Conventional PEMEC

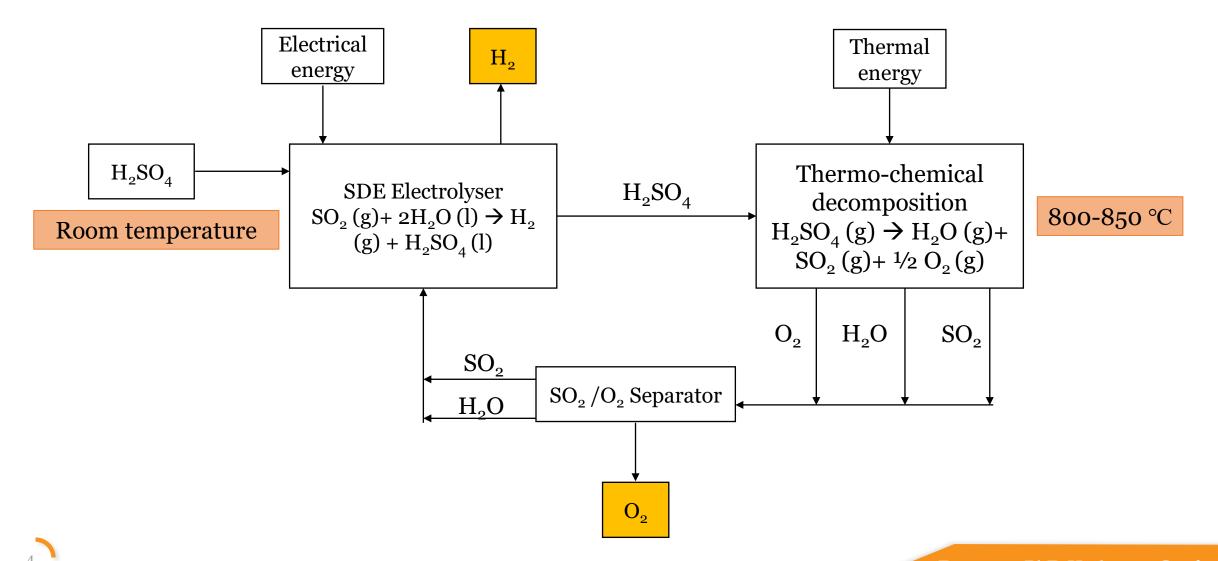


- Lower energy requirements
- Sustainable large scale hydrogen production
- The operating voltage range is 0.5 to 1.2 V which is much lower than that for PEM water electrolyser (1.6 to 2 V)
- The efficiency from electricity to H_2 is much higher than PEMEC
- SDE can be used in mining industry allowing onsite H_2 production using spent sulfuric acid and SO_2 .



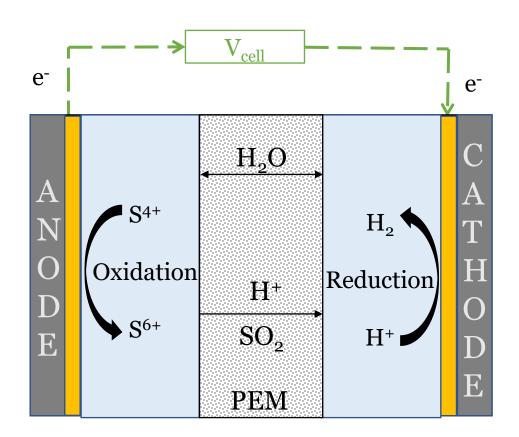
Hybrid Sulphur Cycle (HyS)





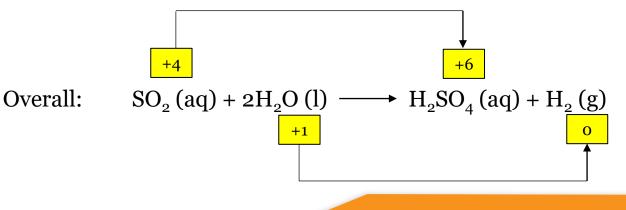
Brecher, L., S. Spewock, and C. Warde, The Westinghouse sulfur cycle for the thermochemical decomposition of water. International Journal of Hydrogen Energy, 1977. 2(1): p. 7-15

Working principle of SDE



- ✓ First presented by Juda and Moultan in 1967 for cheaper H₂ production for use in basic chemicals
- ✓ E^o = 0.158V (can only be realized between 0.5-1.2V) in comparison to water electrolyser with E^o = 1.23V
- ✓ SDE would only require 25-60% of the electrical energy compared to the conventional electrolyser

Anode: $SO_2(aq) + 2H_2O(l) \longrightarrow H_2SO_4(aq) + 2H^+ + 2e^-$ Cathode: $2H^+ + 2e^- \longrightarrow H_2(g)$



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Juda, W. and D. Moulton, CHEAP HYDROGEN FOR BASIC CHEMICALS. 1967, Prototech Co., Cambridge, Mass.

Bibliometric Analysis







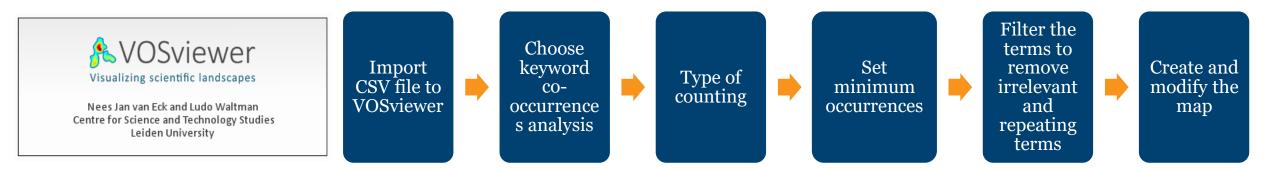
- ✓ Helps improving the quality of future papers by allowing authors to consider the success from the past.
- ✓ Saves time for future authors by helping them identify relevant papers quickly.
- ✓ Reveals information in connection to the field's growth and impact, and the key contributors and publications within that field.

Kar, S.K., S. Harichandan, and B. Roy, Bibliometric analysis of the research on hydrogen economy: An analysis of current findings and roadmap ahead. International Journal of Hydrogen Energy, 2022.

Data gathering and analysis







Van Eck, N. and L. Waltman, Software survey: VOSviewer, a computer program for bibliometric mapping. scientometrics, 2010. 84(2): p. 523-538.

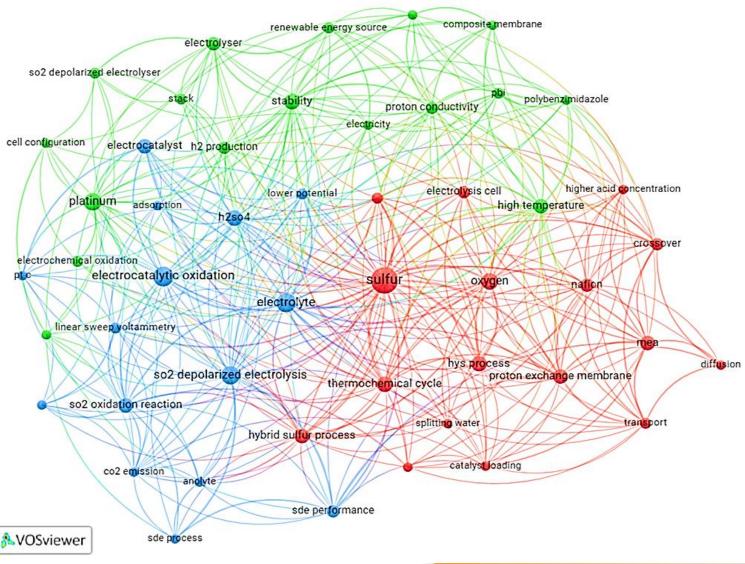
Keyword Co-occurrences Analysis



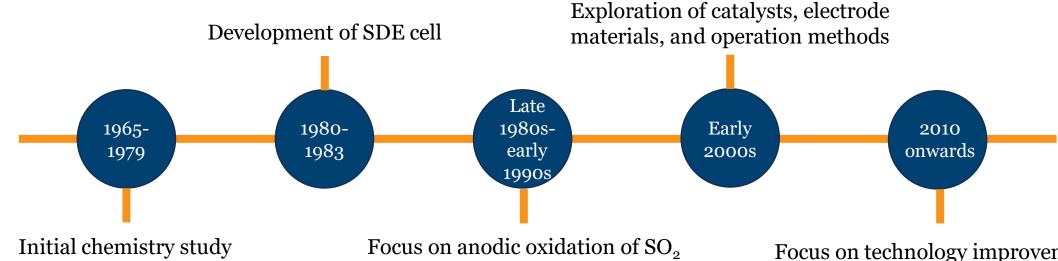
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- Red cluster: Initial years of development of the SDE
- Blue cluster: Basic concepts surrounding SDE
- Green cluster: Enhancing the SDE for higher H₂ production



Evolution of the field of SDE



Development of hybrid sulphur (HyS) cycle

Sno.	Country	Number of documents	Citations	Average citations
1	USA	21	467	22.2
2	China	10	70	7
3	South Korea	9	43	4.8
4	Spain	6	42	7
5	Finland	5	54	10.8

Focus on technology improvement, catalyst development, membrane exploration, scalability studies, and cost reduction strategies

Α

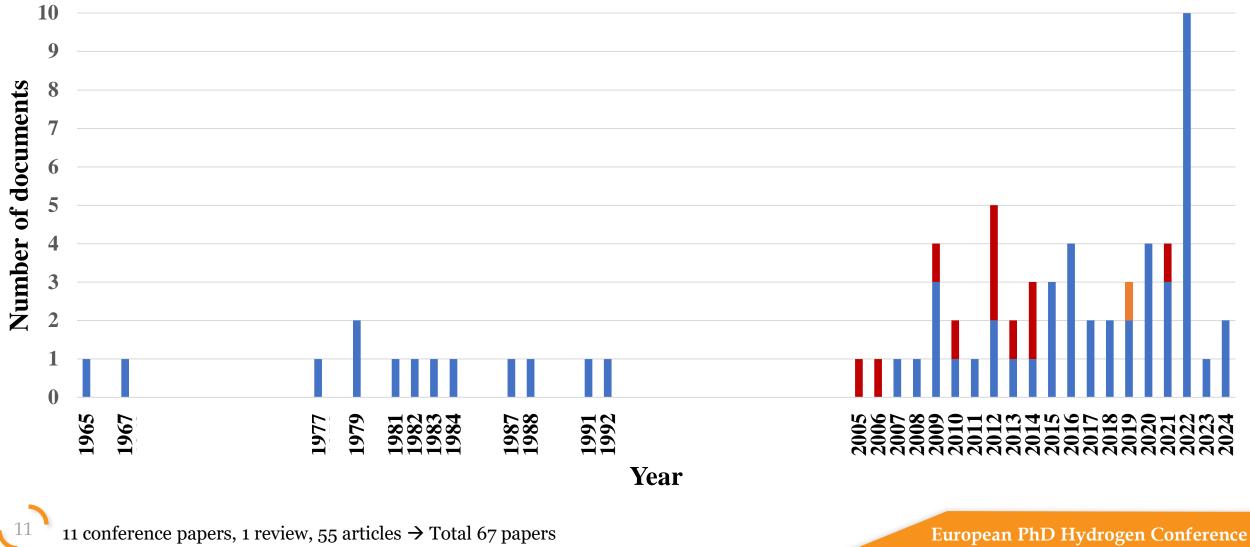
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Evolution of the field of SDE

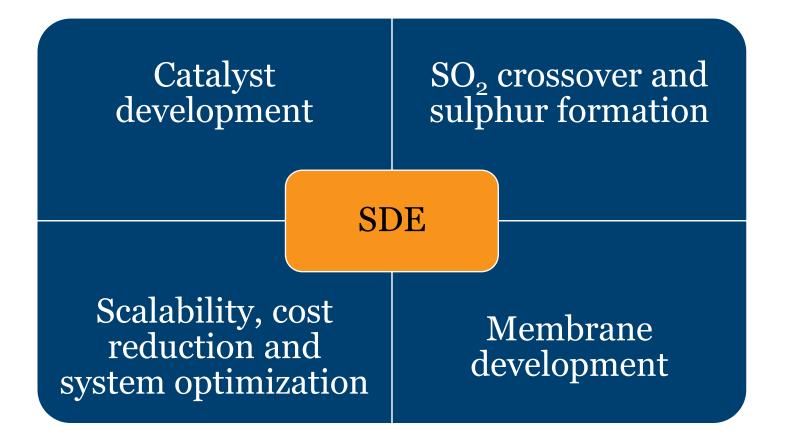


Article Conference paper Review



20.03.2024





Santasalo-Aarnio, A., et al., Performance of electrocatalytic gold coating on bipolar plates for SO2 depolarized electrolyser. Journal of Power Sources, 2016. 306: p. 1-7.







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