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Bipolar Electrodes With Gas-Transporting Layers

Stanford researchers have developed an innovative replacement of bipolar membrane (BPM) electrodialysis, called bipolar electrode (BPE) to split water into separate streams of protons and hydroxide ions more efficiently and cost effectively.

The use of acid and base reagents in industrial chemical processes often leads to the production of large amounts of salt by product. Instead of treating the salt as waste, electrochemical technology can be employed to regenerate acid and base from the salt and water. Current state of the art technology, bipolar membrane (BPM) electrodialysis, is not very efficient or durable for splitting water into protons and hydroxide.To address this issue, Stanford researcher have invented the bipolar electrode (BPE) comprising two catalyst layers surrounding a gas-transporting layer. One catalyst generates a gaseous product (e.g., hydrogen), transported to the other layer for oxidation, resulting in separate streams of protons and hydroxide ions. The BPE's performance scalability depends on thermodynamic potentials and electrocatalyst effectiveness, and its design prevents parasitic ion crossover, eliminating the need for ion-exchange membranes, presenting significant advantages over BPMs.

Stage of Development
Prototype: small bench-top prototype built

Applications

- Production and recovery of organic acids and bases
- Purification of mineral ores
- Production of cementitious materials

Advantages

- In comparison to gold standard BPE:
  - Total blockage of ion crossover
  - Lower overpotential
  - Increased energy efficiency
  - increases throughput and reduces capital cost
  - Easier manufacturing
  - Greater durability
  - Low cost

Innovators

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