Layer-by-Layer Fabrication of Proton Exchange Membranes for Fuel Cell Stacks
Technology #10730

Applications

This invention will improve electrochemical cells commonly used in electronics, vehicles, etc., and increase the efficiency of portable energy production.

Problem Addressed

Fuel cells typically rely on a constant supply of fuel and oxidant from outside the cell to run continuously through the cell itself. Fuel cells produce less than ideal voltage outputs due to the ohmic losses within the fuel cell caused by electronic impedances through the electrodes, contacts, and current collectors.

Technology

Fabricating fuel cells by using Layer-by-Layer (LBL) technology bypasses the need to use lithographic and sputtering techniques to fabricate a large number of flat microelectrodes. Micropatterned LBL polyelectrolyte graphite electrodes are capable of reducing chemical and mechanical degradation and ensure proper passage of the ions. This allows the fuel cells to be capable of producing open-circuit-potentials similar to a pure metal. A novel proton exchange membrane (PEM) is fabricated by depositing polyelectrolyte LBL films on a porous support. A carbon-based gas diffusion layer (GDL) acts as a current collector and at the same time allows the diffusion of gases. Structural properties of LBL carbon electrodes are different from conventional carbon electrodes due to the polyelectrolytes embedded inside the LBL carbon electrode. By embedding polyelectrolytes inside the LBL carbon electrodes, the fuel cell's performance now depends more on the chemical properties of the polyelectrolytes themselves, and allows one to tune the thickness and permeability, as well as the composition, of these films to match the desired qualities.

Advantages

- Stable electronic conductivity
- No mechanical or thermal processing required during fabrication
- Low cost
- Easy to mass-produce

Categories For This Invention:

Energy
Energy Storage
Fuel Cells
Materials
Thin Films

**Intellectual Property:**
Carbon-polymer electrochemical systems and methods of fabricating them using layer-by-layer technology
Issued US Patent
8,075,951

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**Publications:**
*Fabrication of a “Soft” Membrane Electrode Assembly Using Layer-by-Layer Technology*
Advanced Functional Materials  

*Designing a New Generation of Proton-Exchange Membranes Using Layer-by-Layer Deposition of Polyelectrolytes*
Advanced Functional Materials  
Volume 15, Issue 6, pages 945-954, June, 2005

**External Links:**
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