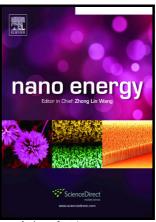
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#### **ACCEPTED MANUSCRIPT**

# **Electrocatalysts by Atomic Layer Deposition for Fuel Cell Applications**

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#### **Abstract**

Fuel cells are a promising technology solution for reliable and clean energy because they offer high energy conversion efficiency and low emission of pollutants. However, high cost and insufficient durability are considerable challenges for widespread adoption of proton exchange membrane fuel cells (PEMFCs) in practical applications. Current PEMFCs catalysts have been identified as major contributors to both the high cost and limited durability. Atomic layer deposition (ALD) is emerging as a powerful technique for solving these problems due to its exclusive advantages over other methods. In this review, we summarize recent developments of ALD in PEMFCs with a focus on design of materials for improved catalyst activity and durability. New research directions and future trends have also been discussed.

**Keywords**: Atomic layer deposition, Fuel cells, Electrocatalysts, Nanomaterials, Catalyst design

#### Introduction

Polymer electrolyte membrane fuel cells (PEMFCs), which can efficiently convert chemical energy into electricity through electrochemical reactions, are considered promising alternative power sources for transportation and portable applications due to their high efficiency, low temperature operation, and zero emissions.[1] Recently, Toyota announced the production of a commercial fuel cell car (four-door family sedan, called Mirai) which entered Japanese markets at the end of 2014 and North American and European markets in mid-2015.[2] Toyota is not

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