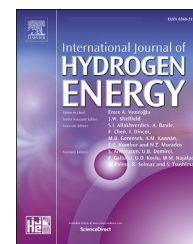


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# Highly dispersed and CO<sub>ad</sub>-tolerant Pt<sub>shell</sub>-Pd<sub>core</sub> catalyst for ethanol oxidation reaction: Catalytic activity and long-term durability

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## ABSTRACT

Highly dispersed Pt<sub>shell</sub>-Pd<sub>core</sub> catalyst is synthesized via an electroless deposition and a galvanic displacement. From electrochemical analysis, the catalyst is confirmed to be active toward an ethanol oxidation reaction for a prolonged time, and is more resistive against CO<sub>ad</sub>-poisoning than a conventional Pt/C catalyst. The stable activity of Pt<sub>shell</sub>-Pd<sub>core</sub>/C is ascribed to the modified electronic property of Pt over-layer, which leads to a weak CO-adsorption strength with a high affinity for OH. The weakened binding property of surface Pt with CO<sub>ad</sub> was experimentally confirmed by conducting a CO<sub>ad</sub>-stripping and by measuring an electrochemically active surface area of the catalyst over multiple cycles. The CO<sub>ad</sub> oxidation ability of as-synthesized catalyst is further proved by a computational method via density functional theory (DFT) calculation. The result presents a potential application of the catalyst for the efficient ethanol oxidation in a direct ethanol fuel cell.

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## Introduction

Much attention has been made to proton exchange membrane fuel cells (PEMFCs) due to its versatility as a power source for portable electronics and electric vehicles [1–5]. PEMFCs are classified into H<sub>2</sub>-PEMFC (gaseous hydrogen) and direct alcohol-PEMFC (methanol, ethanol), based on which type of fuel is oxidized to generate electrons. Of those, direct alcohol-PEMFC is more advantageous than H<sub>2</sub>-PEMFC, in terms of easy

storage, transportation, and high volumetric-/gravimetric energy density [6–8].

For the last two decades, direct methanol fuel cell (DMFC), one of the direct alcohol-PEMFCs, has been widely investigated as a future power source. However, methanol is toxic as well as volatile, and therefore it is not an ultimate replacement for H<sub>2</sub>. As an alternative fuel, ethanol provides more advantages; safer, more energy density compared to methanol (8.01 kWh kg<sup>-1</sup> vs. 6.09 kWh kg<sup>-1</sup>) [9,10]. Therefore,

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