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Atomic Scale Co-Clusters Decoration Enables High-Rate ORR Performance of Co-Oxide Supported Pd Nano-islands

Hong-Wei Chang[1] and Tsan-Yao Chen[1,2]*

[1] Department of Engineering and System Science, National Tsing Hua University, Hsinchu 30013, Taiwan

[2] Institute of Nuclear Engineering and Science, National Tsing Hua University, Hsinchu 30013, Taiwan.

wl00470593@gmail.com

Abstract

The prohibitive cost and scarcity of the noble-metal catalysts needed for catalyzing the oxygen reduction reaction (ORR) are major limitations for the commercialization of fuel cell technology. Identifying materials design with expected properties can accelerate the development of highly active and abundant transition-metal-based catalysts with low platinum loading. In this study, to enhance and optimize nanocatalysts (NCs) performance for ORR, a series of ternary metallic NCs consisting of Co atomic clusters decorated Pd nano-islands over CoOx support underneath (denoted by CPCo) in different ratios of Co/Pd from 1 to 9 wt.%, are synthesized by using robust wet chemical reduction method with processes control. The as-developed CPCo NC with 9 wt.% of Co-content (CPCo-9) exhibits unprecedented high mass activity (MA) of 4394 mAmg-1 at 0.85 V vs RHE in 0.1 M KOH electrolyte towards ORR, which outperforms the commercial J.M.-Pt/C catalyst (67 mAmg-1). More importantly, the CPCo-9 NC exhibits remarkable durability when operated up to 22k accelerated durability test (ADT) cycles and retains its 100% performance as that of initial condition.

Keywords: accelerated durability test, oxygen reduction reaction, nanocatalysts