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Carmelo Lo Vecchio, David Sebastián, Cinthia Alegre, Antonino Salvatore Aricò, Vincenzo Baglio

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Carbon-supported Pd and Pd-Co cathode catalysts for direct methanol fuel cells (DMFCs) operating with high methanol concentration

Carmelo Lo Vecchio*, David Sebastián, Cinthia Alegre, Antonino Salvatore Aricò, Vincenzo Baglio*

CNR-ITAE Institute, Via Salita Santa Lucia sopra Contesse, 5, 98126, Messina (Italy)

* Authors to whom correspondence should be addressed; E-Mail: baglio@itae.cnr.it; lovecchio@itae.cnr.it.

Tel.: +39-090-624237; Fax: +39-090-624247

Abstract: Carbon-supported 30% Pd-based catalysts such as Pd/C, Pd_4Co_1/C and $Pd_{10}Co_1$/C were prepared by the sulphite complex route and physico-chemically characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), energy-dispersive X-ray (EDX) and X-ray photoelectron spectroscopy (XPS). The electrochemical investigation was carried out in half cell and direct methanol fuel cell (DMFC) to evaluate the performance, the tolerance to permeated methanol and the durability of the Pd-based electrocatalysts. For comparison, a commercial 30% Pt/C catalyst was also electrochemically investigated. The advantage of using a high methanol concentration in DMFCs is related to a high energy density. Unfortunately, methanol crossover causes a mixed potential at Pt cathode catalysts reducing the overall cell efficiency, which is exacerbated with high methanol concentration (10 M) at the anode side. Pd and Pd-Co alloys based electrocatalysts exhibited high methanol tolerance properties, as evidenced in the half cell characterization, which led also to high performances in single cell configuration (DMFC). Thus, Pd-based electrodes represent a reliable way to minimize the cost in low temperature fuel cells, providing a higher performance than that of Pt-based electrodes at high methanol concentration.