Ethanol electro-oxidation on Pt/C and Pd/C catalysts in alkaline media

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Recently, increasingly attentions have been paid to the electro-oxidation of ethanol in alkaline media in the context of using ethanol as a fuel in anion-exchange membrane fuel cell. Alkaline media presents several advantages compared to acidic media. It has been found that the electrocatalytic activity for ethanol oxidation in alkaline media is much higher than that in acidic media [1]. Furthermore, the selectivity for ethanol electro-oxidation to CO₂ could be improved significantly in alkaline media [2]. More importantly, from a material point of view, besides Pt, a much wider range of electrode materials are stable in alkaline environment [3], which could be used as catalysts for direct ethanol fuel cell.

Among the non-platinum catalysts, Pd exhibits interesting catalytic activity for ethanol oxidation in alkaline media [4]. However, comparing to the comprehensive fundamental understandings of ethanol oxidation on Pt, only few studies have been reported so far involving the ethanol electro-oxidation on Pd. In this study, the ethanol electro-oxidation behaviors on the Pt/C and Pd/C in alkaline media were compared by potentiodynamic and potentiostatic methods under different ethanol concentration, pH and temperature.

It was found that Pt/C catalyst showed more severe poisoning than Pd/C, especially when high concentration ethanol was used. When increased the pH of solution, the ethanol oxidation activities on both catalysts were improved, while this improvement is more profound for Pd/C. Furthermore, the effect of temperature for ethanol oxidation was investigated. As shown in Fig. 1, when temperature increased, the CV shape of ethanol oxidation on Pt/C was changed and a shoulder peak gradually increased monotonously with temperature, indicating that the ethanol oxidation mechanism on Pt/C did not change under the temperature investigated. The apparent activation energies of ethanol oxidation on Pt/C in alkaline media varied from 32-34.8 kJ mol⁻¹ at potential range of 0.4 – 0.55 V, much lower than the corresponding values on Pt/C catalyst in acidic media under the same potentials [5]. Compared to Pt/C, the Pd/C showed much higher selectivity towards ethanol oxidation.

![Scheme 1. Proposed mechanism for ethanol electro-oxidation in alkaline media.](image)

References