Carbon and Carbide Derived from Lotus Stem as Electrocatalyst Supports for Methanol Electro-Oxidation

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Methanol shows potential as a promising alternative fuel to hydrogen in fuel cells. Platinum has been identified as a capable catalyst due to its high activity and stability for methanol electro oxidation. The support materials play important roles on the activities and stabilities of the catalysts. Herein, lotus-stem derived carbon (denoted as LC) with porous structure was synthesized by using lotus stem as carbon source. Pt supporting on LC (Pt/LC) as catalyst for the methanol oxidation reaction (MOR) was explored. Then tungsten carbide (WC) and molybdenum carbide (Mo_2C) were synthesized using lotus carbon as the carbon source. This was followed by investigating the lotus derived tungsten carbide and molybdenum carbide with nano- Pt/LC catalyst to further improve the activity and lower the over potential for methanol oxidation. Studies into lotus stem derived tungsten carbide (WC-LC) addition showed that the catalysts have been formed with smaller, more uniform platinum particles, and catalysts with WC contents had higher mass activities and lower onset- and peak- potentials than Pt/LC, which effectively demonstrated the synergistic effect of WC on Pt. Results indicate that the LC favors both mass transfer and dispersions of WC and Pt, leading to excellent MOR activity and stability of the Pt/LC and Pt/WC-LC, by comparing with the commercial Pt/C and Pt/C-WC(commercial carbon powder supported WC and Pt). Investigations into the lotus derived molybdenum carbide (Mo_2C-LC) effect showed similar mass- and specific-activities for catalysts as the WC-LC. Significantly, the insights garnered from this study on the fundamental properties required for early activation, activity and stability of the platinum catalysts could lead to a more intellectual design of lotus derived carbon as a potential catalyst support and Pt/WC-LC and Pt/Mo_2C-LC as electro catalysts in future.

Keywords: Lotus stem, methanol oxidation, molybdenum carbide, tungsten carbide