Catalyzing Renewable Energy Conversion Reactions by Non-Precious Metal M-N/C Catalysts

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Non-precious metal catalysts (NPMCs) have emerged as alternatives to expensive precious metal (Pt, Ir, or Ru) based electrocatalysts in renewable energy conversion reactions. Among various NPMCs, M-N/C (M = transition metal) catalysts have been suggested as the most promising class of NPMCs, owing to their high catalytic activity. In this presentation, we show our recent efforts for designing M-N/C electrocatalysts for oxygen reduction reaction (ORR). We developed a general design strategy based on "silica-protective-layer-assisted" method that can preferentially generate ORR-active Fe-N_x sites towards highly efficient Fe-N/C electrocatalysts. The prepared Fe-N/C catalysts showed excellent ORR activity in alkaline and acidic electrolytes, and demonstrated high current and power densities for both acidic and alkaline polymer electrolyte fuel cells. In addition, the synthetic strategy was extended to Co-N/C and Ni-N/C catalysts, which demonstrated promising catalytic activity for hydrogen evolution reaction and CO_2 reduction reaction, respectively.