摘要

直接甲醇燃料電池是分別在陽極供給甲醇和水，陰極供給氧氣，利用氧化還原反應產生電能。近年來，直接甲醇燃料電池的研究重點在於更高的效率與更低的成本。在本論文中同時將觸媒與碳載體的尺寸縮小至奈米等級，在碳載體的部份，利用離子束濺鍍系統將鐵-鈦合金顆粒沈積在碳布上以做為成長奈米碳管所需的觸媒，緊接著用微波電漿輔助化學氣相沈積法在碳布上成長奈米碳管，有別於傳統塗佈製程，以直接成長於碳布上的奈米碳管做為載體，不但降低了碳管與碳布間的界面阻抗，奈米碳管同時具有高表面積與高電子傳導能力的特性，可以稱職地扮演好載體的角色。

本實驗是使用膠體法合成鉑釕二元合金奈米顆粒，將奈米碳管/碳布放入此膠體溶液中，再藉由外加電場使溶液中的帶電膠體向載體移動並沈積在載體上，即所謂電泳。改變外加電場和沈積時間，都會影響載體上鉑釕觸媒的負載量、分佈情形以及表面形貌等，進而影響觸媒活性的大小，經過分析後，由 TEM 得知其平均粒徑約 2 nm，在奈米碳管上鉑觸媒的負載量約 6~8 μg/cm^2，其中最好的實驗條件所對應之觸媒活性為 1.85 A/cm^2/mg Pt，與既有文獻比較可知本研究成功地使用低觸媒用量即得到很好的活性表現。

關鍵字：鉑釕奈米顆粒、奈米碳管、電泳、直接甲醇燃料電池

Abstract

Direct methanol fuel cell (DMFC) can convert the chemical energy to electrical power based on redox reaction by means of feeding methanol, water and oxygen into the anode and cathode, respectively. To date, the control of catalysts loading, size and dispersion to achieve high performance is essential in DMFC. In this thesis, the nanotechnologies were utilized to synthesize electrodes of the carbon supporter and electrocatalysts. Hence, carbon nanotubes (CNTs) were grown by microwave plasma enhanced-chemical vapor deposition on the carbon cloth (CC) and the catalyst for CNTs growth was iron-titanium alloy particles synthesized by ion beam sputtering deposition. The directly grown CNTs on CC not only reduced the interfacial resistance but also can play important role in carbon supporter.

Furthermore, the colloidal method was used to synthesize the colloid of Pt-Ru alloy nanoparticles, which the size of particle can be controlled in the range of 2-3 nm. Afterward, the electrophoretic deposition technique was introduced to control the loading of Pt-Ru particles onto the CNTs/CC. The effects of extra-applied electric field and deposition time were systematically investigated. The analysis of catalytic active, loading amount of catalyst, and surface morphology were performed by the cyclic voltammetry, ICP, XPS, XRD, SEM and TEM.

Keywords：PtRu nanoparticles, Carbon nanotubes, Electrophoresis, Direct Methanol Fuel Cell