

Preparation of Eggshell-Type Ru/Al<sub>2</sub>O<sub>3</sub> Catalysts for Hydrogen Production Using Steam-Methane Reforming on PEMFC

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Ru-based eggshell-type catalysts, in which Ru is located at the outer region of the pellet, were prepared by the impregnation method, using spherically shaped  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> pellets for steam-methane reforming (SMR). Ru was only supported on the external region of the pellet because of the strong interaction between its precursor and the alumina pellet. The Ru precursor penetrated the inside of the pellet by adding nitric acid to the impregnation solution. The distribution and thickness of the Ru layer in the catalyst can be controlled using the HNO<sub>3</sub>/Ru molar ratio and contact time at the impregnation step. Among the catalysts, the graded eggshell-type catalyst showed the highest activity and long-term stability in the SMR reaction. In addition, in the daily startup and shutdown (DSS) operation, similar to the hydrogen production environment for domestic polymer electrolyte membrane fuel cells (PEMFC), the graded eggshell-type catalyst showed high activity and stability after multiple cycles. Based on the experimental studies, it was confirmed that Ru-based catalysts are suitable for steam-methane reforming for PEMFC.