Enhanced Catalytic Oxygen Reduction Performance from Titania Supported PtPb Nanoparticles

Takao Gunji[1], Govindachetty Saravanan[2], Shingo Kaneko[3], Genki Kobayashi[1], Futoshi Matsumoto[1]

[1]Department of Material and Life Chemistry, Faculty of Engineering, Kanagawa University
3-27-1, Rokkakubashi, Kanagawa-ku, Yokohama-shi, Kanagawa 221-8686, Japan
[2]CSIR-National Environmental Engineering Research Institute (CSIR-NEERI), Nehru Marg, NAGPUR-440020, India.
[3]Research Institute for Engineering, Kanagawa University,
3-27-1, Rokkakubashi, Kanagawa-ku, Yokohama-shi, Kanagawa 221-8686, Japan

Stable and long-term electrocatalytic performance towards cathodic oxygen reduction reaction (ORR) was achieved by impregnation of PtPb nanoparticles (NPs) on *anatase* titania (TiO_2) support. Organometallic precursors, $H_2PtCl_6.6H_2O$ and $Pb(CH_3COO)_2$ and TiO_2 supports were mixed in anhydrous methanol and then co-reduced using sodium borohydride. Finely dispersed PtPb NPs with the average particle size between 2 and 4 nm were achieved through wet-chemical synthetic route. PtPb/TiO_2 showed superior catalytic activity both in terms of onset potential as well as cathodic current density than that of Pt/TiO_2 towards ORR. The onset potential and cathodic current density of PtPb/TiO_2 was 0.60 V and -0.89 mA mg^{-1} at 0.2 V. Whereas, the onset potential and cathodic current density of Pt/TiO_2 was 0.43 V and 0.17 mA mg^{-1} at 0.2 V. Both onset potential and cathodic current density were not altered over 50 cycles in the case of PtPb/TiO_2, however, greatly altered in the case of Pt/VC. The leaching of Pb from PtPb NPs-dispersed on TiO_2 was greatly suppressed than that of TiO_2-free or Vulcan carbon (VC) supported PtPb. Impregnation of PtPb on TiO_2 can be the practical cathodic electrode catalytic materials for fuel cells in terms of its stable, enhanced catalytic performance, and leaching tolerance.