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Investigation of Pt-supported nanographene produced by in-liquid plasma for development of polymer electrolyte fuel cells

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Recently, various fuel cells, such as polymer electrolyte fuel cell (PEFC), are attracting a lot of attention owing to small size and at relatively low working temperature (below 80°C), which makes possible usage of PEFCs in automobile and household power generation. However, PEFC has a problem with decrease of output caused by corrosion of amorphous carbon used as a catalytic carrier, which could be solved by use of carbon nanostructures with stronger crystal structure than amorphous carbon. In this work, nano-graphene supported by Pt nanoparticles was synthesized and examined for possible application in development of PEFC with increased durability. Nano-graphene was synthesized by in-liquid plasma generated in ethanol using AC high voltage (~11.7 kV). Amorphous component of synthesized nano-graphene was removed by hydrogen peroxide treatment and removal of amorphous carbon was confirmed by Raman spectroscopy. Platinum (Pt) nanoparticles were prepared on the surface of nano-graphene by the reduction of Pt salt precursors (H2Cl6Pt) in solution. Formation of Pt nanoparticles of diameter in range 2-4 nm was confirmed by transmission electron microscopy and X-ray diffraction measurement of Pt-supported nano-graphenes. Membrane electrode assembly (MEA) was constructed, where Pt-supported nano-graphene was used as the catalytic layer. Power generation characteristic of MEA were evaluated and current density for developed MEA was approximately 240 mA / cm2. From the electrochemical evaluation of Pt-supported nano-graphene, it was found that durability of Pt-supported nano-graphene was about seven times higher than that of carbon black, which looks promising for improvement of durability of PEFC.

Biography

Vladislav Gamaleev has completed his PhD at Kochi University of Technology, Japan. He is a Postdoctoral Researcher at Meijo University. His research interests include "Generation of plasma at atmospheric and high pressure in gas and liquid phase, and plasma diagnostics by optical emission spectroscopy". Currently, he is focusing on the generation of oxygen radicals by atmospheric pressure plasma for biological and agriculture applications. He is a member of Japan Society of Applied Physics (JSAP).

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