Popular abstract

Durable catalyst development for PEMFC

Why investigate fuel cells?

The need to reduce our reliance on fossil fuels has become increasingly evident. An example of this is the environmental impact caused by the growing use of transportation around the world. A shift toward new technologies which can be operated using fuels produced from low greenhouse gas sources is therefore required. Particularly appealing is the hydrogen powered fuel cell utilizing PEM (proton exchange membrane) technology, due to its compact nature and high energy density and efficiency. Hydrogen can be produced by renewable sources, such as windmills and solar panels, using electrolysis in which a current is used to split water into hydrogen and oxygen. In the fuel cell, hydrogen, stored in a pressurized tank, is electrochemically reacted with oxygen from the atmosphere to generate electricity when needed, producing water vapor as the only emission.

What is the research problem?

One of the major hurdles for the commercialization of hydrogen fuel cells is the catalyst. Fuel cells typically employ catalysts composed of the expensive noble metal platinum, dispersed on a support material made of carbon which helps in utilizing the platinum to its fullest extent. However, the harsh chemical environment inside the fuel cell causes the support material to slowly degrade, resulting in a loss of activity which eventually requires the fuel cell to be replaced. One option is to substitute carbon with other materials that are more stable under the conditions experienced inside the fuel cell. The task of producing such new materials is a challenging one: the ideal support material must also satisfy other demands such as having a high surface area and high electrical conductivity.

How does this thesis contribute to solving the problem?

In accordance with the above, we have looked into the development of synthesis methods for tungsten carbide, which is a promising ceramic material that could potentially replace current support materials. The use of durable carbon materials, such as carbon nanotubes, was also investigated. Additionally, we have further developed protocols for electrochemical analysis of catalysts and their support materials.