Stability of carbon supported platinum particles (Pt/C): Effect of dispersant and pH

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Carbon supported platinum particles (Pt/C) are used as catalysts in proton exchange membrane fuel cells (PEMFCs). They promote the oxidation of hydrogen on the anode and the reduction of oxygen on the cathode. [1] The catalyst layers for the PEMFCs are produced as ink formulations which are then applied directly on the membrane by means of different solution-coating methods (e.g. ultrasonic spray coating). The formation of a homogeneous coating layer depends on the ink formulation and processing steps. [2]. In order to optimize the viscosity and the surface area, the main goal of the ink processing is to obtain well dispersed Pt/C suspensions. [1]

We investigated the effect of the dispersing solvent and surfactant on the particle size, size distribution as well as on the surface charge (zeta potential) of carbon black and Pt/C particles. The impact of the pH value was also monitored by using a dynamic light scattering system equipped with an automatic titration unit.

The narrow particle size distribution as well as the strongly negative zeta potential measured for Pt/C particles confirm the stabilizing effect that platinum particles have for the carbon support.

However, mixed with a KCl and surfactant solution, the Pt/C particles show a high agglomeration tendency at pH < 5 in comparison with a dispersion of the particles in distilled water and surfactant. In the acidic range the ionic strength of the solution causes a compression of the electric double layer present on the particle surface leading to a decrease of electrostatic repulsion and thus resulting in a lower magnitude of the zeta potential.

Information about particle size and formulation stability are of high importance in the design of experiment phase for the characterization of major properties, which can have an impact not only on the catalyst layer production but also on the fuel cells performance.

References

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[2] Wang, Min & Park, Jae & Kabir, Sadia & Neyerlin, Kenneth & Kariuki, Nancy & Lv, Haifeng & Stamenkovic, Vojislav & Myers, Deborah & Ulsh, Michael & Mauger, Scott, ACS Applied Energy Materials, 9 (2019) 6417-6427

Figures

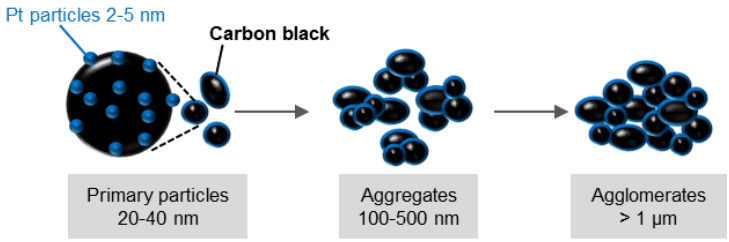

Figure 1: Carbon support of Pt/C catalyst as primary particles, aggregates and agglomerates. Adapted from [2]