Fuel cells

Storing electricity into fuels is a promising way to solve the intermittency problem of solar cells and wind turbines. However, in order to start implementing renewable fuels, the conversion process from these fuels back to electricity needs to be carried out efficiently and cheaply. Fuel cells are devices that can convert a great variety of chemical fuels into electricity and can be operated in a wide range of operational conditions (e.g., temperatures). This way, advances in fuel cells research can make renewable fuels a reality, which can play an important role in the energy transition.

Challenges

One of the most important components in a fuel cell are the catalysts at the anode and cathode of the fuel cell. The size and composition of these catalysts need to be optimized to overcome common catalyst issues, such as low activity and catalyst poisoning. However, not only the catalyst properties need to be optimized in fuel cells but also the way the catalyst is integrated into the device, which may consist of a gas diffusion layer, catalyst support and a membrane (see illustration below). Proper integration of these components should maximize the ion conduction and mass transport in the catalyst layer. Therefore, in order for fuel cell applications to have an economical and environmental impact in our society, research tools are needed to speed up the optimization of the catalyst and its integration into a fuel cell device for specific fuels and applications.

TECHNICAL INPUT

Particle Source	VSP-G1
Deposition Method	Impaction
Deposition System	VSP-A3
Deposition Parameters	N/A
Sample	Carbon cloth
Material	Pt alloys
Application	Fuel cells
Analysis technique	TEM

Solution

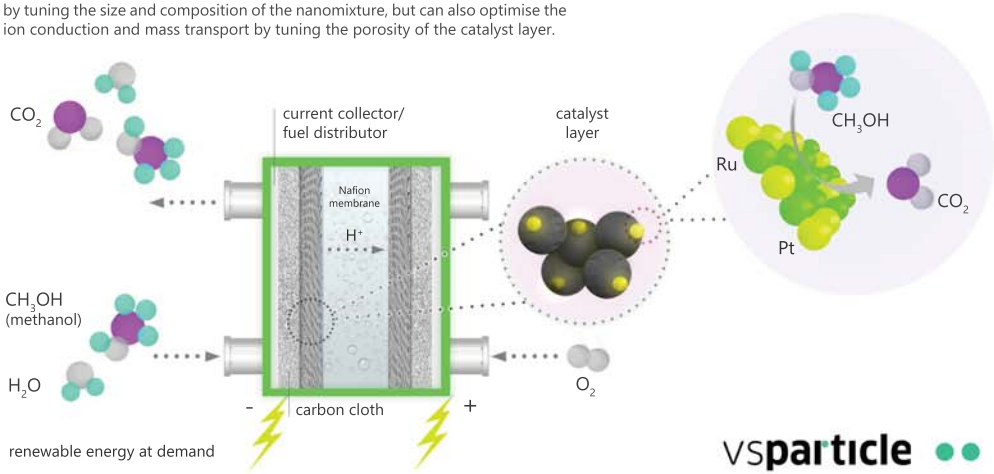
The particle generator VSP-G1 efficiently produces pure nanoparticles with full control over their size and composition, which can be easily mixed in the gas phase with a supporting material (carbon) in the nanoscale. Moreover, VSPARTICLE tools allow the deposition of this optimizable nano-mixture into a substrate (diffusion layer or membrane) with control over the porosity of the film. This way VSPARTICLE technology can optimize the most important components of a fuel cell (illustrated below for a direct methanol fuel cell) at a push of a button.

Example experiment setup

Supporting carbon particles and alloy catalyst particles (e.g., Ru-Pt) can be produced separately in two different particle generators (VSP-G1) and mixed in the gas phase as they are impacted on a suitable substrate (e.g., carbon cloth). By changing the impaction parameters the porosity of the film can be tuned.

Direct-methanol fuel cell

- Not only can VSPARTICLE tools optimise the catalytic activity of the catalyst layer by tuning the size and composition of the nanomixture, but can also optimise the ion conduction and mass transport by tuning the porosity of the catalyst layer.



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