“Hungry” fuel cell

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This talk discusses the laws of the fuel consumption in a polymer electrolyte fuel cell and its related performance. These laws are presented in an analytical form and are particularly useful for comparison with experimental data and gaining new information from this comparison. First we verify these laws with space resolved current voltage measurements in a *single channel fuel cell*. Next, we compare them with three dimensional computer simulations based on numerical solutions of the nonlinear equations that characterize key transport phenomena and reactions; we see that the theory is basically reproduced by the simulations.

The results give a picture of the inside-the-cell distribution of performance associated with fuelling and the regimes of the fuel cell starvation when fuelling and/or flow field design are not optimized. This picture helps to understand the modes of *smart fuelling* and is lessening for developing alternative designs of the feeding flow fields.

One bit of information to write home about is that we show that in quite a number of cases and flow field architectures a substantial part of the cell does not generate current at all! Smart, stoichiometry-optimized fuelling is needed to extract from cells and stacks the maximum of what they can deliver.

S*haring information about important elements of the cell performance, otherwise not openly discussed,* brings us closer to a complete functional map of a fuel cell without which R&D in this area would be, to a high degree, a subject of trial and error. This is essentially the main target of the talk. Another aspect that is worth of mentioning is the importance of simple analytical theory, which –as will be shown in the talk – works amazingly well for description of fuelling, practically without any adjustable parameters. In combination with specially designed experiments the theory can illuminate the performance of the fuel cell; this helps a lot in focusing the time-consuming numerical modelling, instead of simulating the system behaviour ad hoc.

Literature:

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