Identification of local heterogeneities in direct methanol fuel cells with a physical 2D model

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Understanding the physical phenomena which lead to degradation in direct methanol fuel cells (DMFCs) is crucial to develop cells with improved performance and durability. During operation, DMFCs show strong performance degradation, which can partially be recovered by suitable operating strategies [1]. This reversible performance loss is highly dependent on the local conditions, e.g. local potential and species concentrations within the cell. Experimentally, those aspects are not easily accessible and physical models can help to provide further insights into this topic.

We present a transient, two-dimensional single cell model for DMFCs. The model is implemented in our in-house CFD code *NEOPARD-FC*, which is developed at DLR based on the open-source framework DuMu^x [2]. With this model, we aim to describe the physical processes inside a DMFC. It provides insights into local conditions, like gas and liquid distribution or temperature profiles. This allows us to investigate how heterogeneities in DMFC affect cell performance and degradation.

The modeling domain comprises both channels and the MEA. The catalyst layers are spatially resolved on both sides. The model uses a multiphase, multicomponent Darcy approach to describe gas and liquid transport in the porous media of the electrodes. It includes electrochemical phenomena and takes into account the mixed potential at the cathode, which results from methanol and water crossover through the membrane.

References:

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