High-temperature catalysis: Conversion of ethanol to hydrogen

Background: The employment of highly efficient APUs (*A*uxiliary *P*ower *U*nit) – consisting of fuel reformer and fuel cell (see Figure 1) – for mobile power generation can contribute to reduced greenhouse gas emissions and responsible resource management. Using ethanol produced from renewable resources as fuel for APUs is a further step towards reducing the dependency on limited fossil fuels. Catalytic partial oxidation (CPOX) of ethanol is a promising pathway for hydrogen generation in APUs as no external heat or water supply is required.

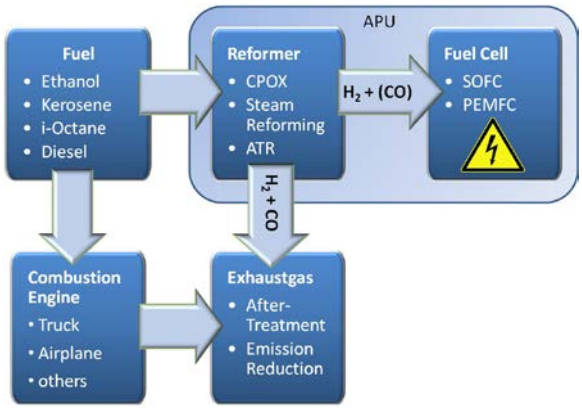

Figure 2: Basic principle of an APU

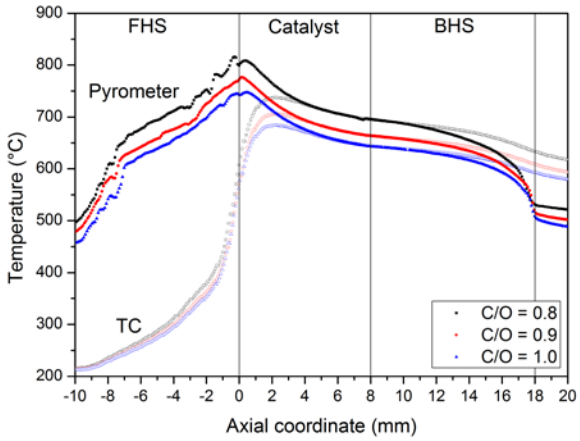

Figure 1: Axial temperature profile for gas-phase (TC) and surface (pyrometer) for different operating conditions

Project: The catalytic partial oxidation of ethanol is a complex reaction network. To gain a profound understanding of this complex system, we use an efficient combination of experimental and modeling approaches. This knowledge is crucial for the design and construction of a CPOX reformer. Furthermore, optimized operating conditions can be achieved.

As an experimental approach, CPOX of ethanol is studied in a laboratory scale reactor on a honeycomb catalyst. The reactor outlet gas composition is analyzed by FT-IR, MS and GC/MS, allowing for a time-resolved monitoring. In addition, with a specially designed sampling technique, it is possible to measure spatially resolved concentration and gas-phase as well as surface temperature profiles (see Figure 2) inside a catalytic channel. The insights from the concentration and temperature profiles lead to a deeper understanding of the complex reaction system in the CPOX reformer. The interaction between heterogeneous and homogeneous reactions is examined. In addition, the dominating reactions at the different axial positions of the catalyst can be identified. Thus, an insight into the mechanism of catalytic partial oxidation is granted.

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