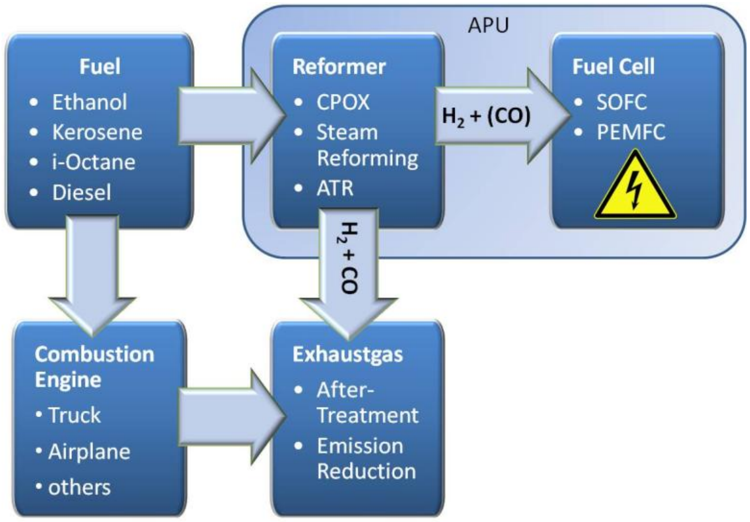
Catalytic Reforming of Kerosene to Hydrogen

Background: The catalytic conversion of logistic fuels via catalytic partial oxidation (CPOX), steam reforming (SR) and autothermal reforming (ATR) to hydrogen-rich synthesis gas provides a powerful tool for both heat and electricity generation by fuel cells or for the conversion into valuable chemicals by processes like Fischer-Tropsch or Haber-Bosch. Important mobile applications are the efficient power generation via APUs (auxiliary power units) and the H2-SCR (selective catalytic reduction) for reducing NO_x-emissions. In the aircraft sector, the catalytic reforming of kerosene-based fuels for the operation of APUs has attended more attention in the past in order to reduce the fuel consumption in the ground operation of airplanes. The main challenge is to optimize the operation conditions due to the highly varying hydrocarbon composition and the sulfur content for different kerosene fuels.



Application of the Conversion of Commercial Fuels to Hydrogen

Project: Our research in the catalytic combustion of crude oil fractions of kerosene and commercial kerosene on rhodium is mainly focused on experimental investigations to maximize the selectivity towards hydrogen and to minimize the deactivation of the catalyst due to coke formation and sulfur poisoning. The experiments are carried out in our CPOX-reactors under autothermal conditions. A series of different analysis tools (FTIR, MS, GC) provide the quantitative determination of a wide range of side-products and main-products in good accuracy. For the experiments, the coke formation and the catalyst deactivation by sulfur, and, regarding to the highly varying composition of diverse kerosene fuels, the different selectivity towards the main product and undesirable coke precursors like olefins will be the major challenge. For the construction of a suitable chemistry model for kerosene, a surrogate mixture will be designed and processed under the same conditions. Additionally, the catalytic process will be improved by simulating various flow configurations, like tail-gas recycling, as well as the detailed heterogeneous and gas-phase chemistry, which will be performed by the programs DETCHEM and FLUENT. The construction of the chemistry model and of a suitable flow configuration is evidential for the main goal of the project, the optimization of the operation conditions and the development of a reformer prototype, which can be used later on as an on-board hydrogen generator for a more efficient method to produce electricity in airplanes.

Co-workers: Julian Nicolaas Bär

Collaboration: Edimilson Jesus de Oliveira - PETROBRAS/CENPES

Fundings: Helmholtz Research School of Energy-Related Catalysis

Selected publications: O. Deutschmann, *Chemie Ingenieur Technik* **2011**, 83, 1954-1963; P. Dagaut and M. Cathonnet, *Prog. Energy Comb. Sci.* **2006**, *32*, 48-92; P. K. Cheekatamarla and C. M. Finnerty, *Int. J. Hydrogen Energy* **2008**, *33*, 5012-5019; M. Hartmann, T. Kaltschmitt and O. Deutschmann, *Catal. Today* **2009**, *147S*, S204-S209; M. Hartmann, L. Maier and O. Deutschmann, *Appl. Catal. A* **2011**, *391*, 144-152; T. Kaltschmitt, C. Diehm, O. Deutschmann, *Industrial & Engineering Chemistry Research*, accepted for publication (12.01.2012);