Universität Bremen

CHEMISCHE VERFAHRENS-TECHNIK

Production and investigation of precious metal-free catalyst materials for the combustion of lean methane gas

Topic description

The catalytic conversion of lean gas enables the flameless conversion of combustible gases below their ignition point. This technology is intended to contribute to the technical usage of methane produced in landfills through biological processes. The use of gas engines is linked to the methane content of the landfill, which decreases continuously as the waste piles age. Therefore, the remaining methane can only be flared off. This is where the above-mentioned technology comes into play.

The thermal energy released during the catalytic reaction is converted into electricity in a downstream gas turbine process. The efficiency of the plant and the emission values depend largely on the gas temperature achieved behind the catalytic reactor. As a general rule, the warmer the better (>900°C).

Precious metal-based catalysts (platinum, palladium) used to date offer excellent reactivity and conversion, but have significant weaknesses in terms of their stability at high process temperatures. As a result, the catalyst ages rapidly (see figure) and the process comes to a standstill.

This thesis aims to investigate the extent to which the precious metal-free catalysts described in various publications can provide a solution. In general, this involves the production of materials with different structures and properties (e.g., spinel, perovskites, hexaaluminates) and their characterization. The aim is to identify a suitable catalyst material that will enable the above-mentioned process to be carried out efficiently and sustainably.

Planned implementation and equipment/tools used

The samples are produced on a small laboratory scale. Ceramic pellets are impregnated with the respective solutions and then calcined in a furnace in several defined steps.

The surface texture of the samples can be viewed and assessed using SEM/EDX. The catalytic activity is also determined within a kinetic reactor with a downstream mass spectrometer.

Depending on the type of thesis (bachelor's or master's) and any prior knowledge, it would also be conceivable to program a simple reactor model in order to classify the kinetic data.

Prior knowledge

Basic experience in laboratory work would be advantageous.