Alternative catalysts and technologies for NOx removal from biomass- and wastefired plants. - DTU Orbit (07/10/2019)

Alternative catalysts and technologies for NOx removal from biomass- and wastefired plants.
The objective of this thesis has been to investigate alternative catalysts and technologies which are able to handle the challenging gasses from biomass- and waste-red units. Nitrogen oxides are unwanted by-products formed to some extent during almost any combustion. These by-products are usually removed with the selective catalytic reduction (SCR) using a vanadia-tungsta-titania (VWT) catalyst and ammonia (NH3) as reductant. For application in coal- and gas-red power plants this technology is mature. However, when ring biomass the ue gas contains potassium in large amounts which deactivates the VWT catalyst very rapidly. Firing of biomass increased strongly over the past decade and is expected to increase even further in the near future. Also waste incineration creates ue gases that are very challenging to the SCR catalyst. Therefore, SCR units in waste incineration plants are commonly placed at the so-called tail-end position, just before being released through the stack. At this position, the ue gas is very clean, so the catalyst has a long lifetime. However, tail-end placement usually requires costly reheating of the ue gas. Two approaches were undertaken to solve the alkali poisoning problem: Use of Ag/Al2O3 as catalyt with hydrocarbons (ethanol, propene) as reductants (HCSCR), and by developing low-temperature catalysts for NH3-SCR to be used in the tail-end position at 150 C, making costly reheating redundant. The hope that HC-SCR is insensitive to potassium has been in vain. The deNOx activity over Ag/Al2O3 used in ethanol-SCR is practically as much reduced as in the NH3-SCR case over the traditional VWT catalyst. Furthermore, poisoning with potassium leads to unselective oxidation of the hydrocarbons instead of NO reduction and SO2 concentrations as low as 20 ppm can heavily deactivate the Ag/Al2O3 catalyst. Therefore we concluded that HC-SCR is unt for potassium containing ue gases. The eorts at developing a catalyst to be used at the tail end position were more fruitful and culminated in a patent application due to which only limited information can be disclosed. At 150 C, in the presence of 10 % H2O, the catalyst under patenting matches the activity of the commercial VWT one at 220 C. However, ue gases at the tail-end position can contain up to 20 % H2O, increasing the temperature of activity parity to 180 C. Furthermore, the catalyst is also sensitive to SO2, even at low concentrations. One of the causes for the catalyst's high activity in NO reduction, the high concentration of chemisorbed surface oxygen, might be exploited in the removal of volatile organic compounds (VOC), another growing environmental technology. Preliminary tests are under planning.

General information
Publication status: Published
Organisations: Department of Chemistry, Centre for Catalysis and Sustainable Chemistry
Contributors: Schill, L.
Number of pages: 195
Publication date: 2014

Publication information
Publisher: Technical University of Denmark (DTU)
Original language: English
Electronic versions:
korrektur.pdf