Removal of Nitrous Oxides from Flue Gas – at the Forefront of Legislation

H. Kolding[1], and R. Fehrmann[2]

[1]DTU Chemistry, Technical University of Denmark
s052396@student.dtu.dk,
[2]DTU Chemistry, Technical University of Denmark
rf@kemi.dtu.dk

ABSTRACT

Flue gas emissions have had a major impact on our environment, both as greenhouse gasses and due to their contribution to acid rain. In 1987, major Danish heat and power plants emitted 163.000 tons of SO_2 and 129.000 tons of NO_x gasses. In 2008 these numbers were 5.000 tons of SO_2 and 20.000 tons of NO_x. The abatement of acidic flue gasses has taken a leap forward, but NO_x is lacking behind.

Removal of NO_x gasses is largely performed by state-of-the-art selective catalytic reduction (SCR) catalysis, where NO and NO_2 are reduced to N_2 by use of NH_3. This method has proved highly useful and robust towards other components of flue gas, but a major byproduct is formation of N_2O either from incomplete reduction of NO (at low temperature) or direct oxidation of NH_3 (at high temperature). Our current legislation concentrates on the abatement of NO and NO_2 gasses, but not of N_2O abatement, probably because there has not yet been developed a sufficiently effective and robust method for this reaction. N_2O is also a potent greenhouse gas and it catalyzes the removal of ozone from the atmosphere. We believe that there can be only one reason for lack of legislation on the emission of this gas, namely lack of a suitable catalyst for its decomposition into N_2 and O_2.

In this course, I have studied a number of new and promising catalysts for the SCR reaction as well as for N_2O decomposition by several common characterization techniques in order to assess the composition of their active sites. This will allow us to propose correlations between loading of active material and catalytic activity for catalytically active metal nanoparticles, as well as analyze the size and composition of the active metal sites on the catalyst. By providing an efficient N_2O catalyst, it is our hope that further reduction of greenhouse gasses may be possible.

Denmark has for many years been a forerunner of environmental legislation which has inspired solutions that also have international commercial perspectives. This process is no different, and an efficient N_2O decomposition catalyst has great potential in a tandem SCR-deN_2O process for complete removal of nitrous oxides from flue gas, lessening emissions for the benefit of our environment.