

# FLUE GAS PURIFICATION

- USING NOVEL FUNCTIONAL CERAMICS



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Pollution from flue gases (exhaust gases), in particular nitrogen oxides ( $\text{NO}_x$ ) and particulate matter (soot), remains a serious threat for human health and the environment. Today, the most widespread technology for the removal of  $\text{NO}_x$  is selective catalytic reduction (SCR) in which a reactant, typically ammonia, is added in the exhaust stream to convert  $\text{NO}_x$  to free nitrogen and water in the presence of a catalyst. SCR is used both in large power plants and in the transport sector.

We are working to improve SCR technology significantly by using novel fibrous nano-materials produced by electrospinning. The main benefits are high  $\text{NO}_x$  conversion, drastic reduction of the pressure drop at the SCR, and the possibility to use a continuous, safe and high throughput manufacturing process.

An alternative, highly promising method uses electrochemical devices made of functional ceramics to clean exhaust gases of both  $\text{NO}_x$  and particulate matter. This is also an active area of research at the department. Compared to traditional flue gas purification using SCR, this concept has the advantages that no extra chemical additives are needed, the electrodes contain no noble metals, and an all-in-one unit can remove both  $\text{NO}_x$  and particulate matter.

Such a device is based on an oxygen ion conductor as electrolyte and works by reducing  $\text{NO}_x$  electrochemically to free nitrogen and oxygen ions. The reduction takes place at the cathode when a voltage is put on the cell. Soot removal is achieved when the oxide ions are pumped through the electrolyte to the anode, where they react with the soot, forming  $\text{CO}_2$ . A similar concept can be used to oxidize CO and uncombusted hydrocarbons.

Our work in the Department for Energy Conversion and Storage has two focuses: developing components for both SCR and for electrochemical devices, and demonstrating complete units as proof of concept. We are taking full advantage of the Department's extensive experience in solid state electrochemistry and advanced ceramic processing.

The construction of reactors and test units is carried out both in-house and in projects in collaboration with industry and research institutions around the world.

### ABOUT THE DEPARTEMENT

We focus on functional materials and their applications for sustainable energy technologies

### FURTHER INFORMATION

[www.energy.dtu.dk](http://www.energy.dtu.dk)

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