Automotive

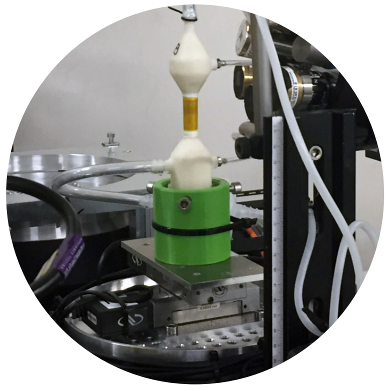
CASE STUDY

Aerosol filtration in a wall flow filter

Particulate matter (PM) pollution remains a major public health concern. The installation of particulate filters on the exhaust of road vehicles with combustion engines has been critical in capturing PM before they pollute the environment.

However, the deposits cause the permeability of the filter to change continuously and over time, without remediation, it can lead to excessive back-pressure from the exhaust, lowering the fuel efficiency of the engine and increasing greenhouse emissions.

The Challenge

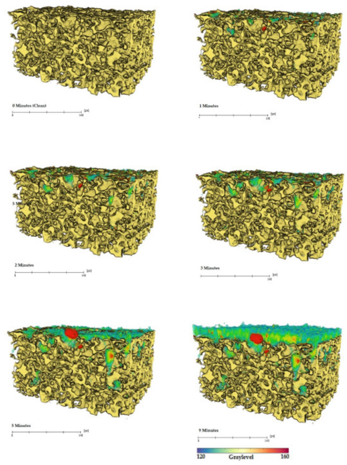


It is critical to understand filter trapping and the 3D distribution of particulate emission in a wall flow filter in order to better control the processes involved.

Understanding the effects of pore scale structural changes in particulate filters, how deposits restrict flow through the filter and how they can be efficiently burnt-off is currently an ongoing challenge, in particular with constantly tightening emissions legislation

A high resolution non-destructive technique was needed to monitor these processes occurring within the particulate filter in greater detail and over time.

The Solution

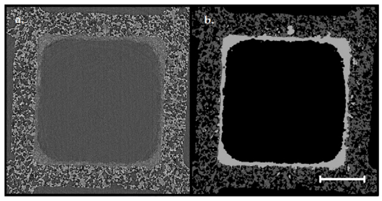


A group of scientists from Johnson Matthey, the University of Manchester, and Diamond developed a new methodology using time-resolved, *in situ* synchrotron micro X-ray computed tomography (micro-CT) on the I13-2 beamline to study aerosol filtration.

This time-resolved *in situ* study followed the interaction of particulate matter (PM) with fresh and aged diesel particulate filters (DPFs). Pore size imaging of aerosol particulate filters under such *in situ* conditions gave a deeper insight into the dynamic changes in the filter's porous media whilst an aerosol was continuously flowed through the sample.

The Benefits

With access to new insights into the mechanisms by which filter efficiency and pressure loss can be affected in service, the concentration of PM output from the exhaust and the fuel efficiency of the vehicle power unit can be better estimated.



This approach can be directly applied to catalyst coated automotive wall flow filters to dynamically image the interface between the soot-like deposits and the catalyst layer. This knowledge can contribute to real world improvements in clean air technology and public health.

Moreover this methodology provides new opportunities for studying the mechanisms by which filter efficiency and pressure loss can be affected by aerosols, and may find additional use for HVAC and PPE applications.

> "This work has provided Johnson Matthey with new methods to study important catalytic filter devices for automotive emissions control. It has given us a deeper understanding of the filtration process and the changes in the filter structure over time through being able to 'see' what is going on inside the filter. The work has also been pivotal in the validation of our computational models of filters"
>
> **Dr Andrew York, Johnson Matthey**

For further information

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