

Microwave-Regenerated Diesel Exhaust Particulate Filter

*Automotive Propulsion System
Materials*

Transportation

FOR THE 21ST CENTURY

U.S. DEPARTMENT OF ENERGY

ENERGY EFFICIENCY AND
RENEWABLE ENERGY PROGRAM

OAK RIDGE NATIONAL LABORATORY



Background

A major goal of the FreedomCAR and Vehicle Technologies Program is to develop a vehicle with outstanding fuel economy that meets stringent emissions standards. Balancing high fuel economy with low emissions is a challenge that is being addressed through materials activities that support the Department of Energy's research and development program for combustion and emission control for advanced diesel engines.

The Technology

Current diesel engine particulate filter technologies depend on a catalyst to assist in the regeneration of the filter. Catalyst technology requires an exhaust temperature of approximately 350°C to be effective. Small diesel engines rarely achieve this exhaust temperature, requiring extended operation at over 70 mph.

Industrial Ceramic Solutions (ICS) is working with ORNL to develop a microwave-regenerated particulate filter for diesel engines. The ICS filter can achieve the required particulate removal efficiencies and can regenerate at low exhaust temperatures.

The unique microwave filter technology is based on the discovery and use of a special silicon carbide fiber that efficiently converts microwave energy to heat energy. These fibers can achieve temperatures of 1200°C in 9 seconds in a standard household microwave oven. A process was developed to incorporate this phenomenon into a filter cartridge and microwave regeneration system for use in diesel engine exhaust streams.

The technology has been demonstrated on stationary diesel engines in test cells at the Ford Motor Company, Oak Ridge National Laboratory, and the University of Tennessee.

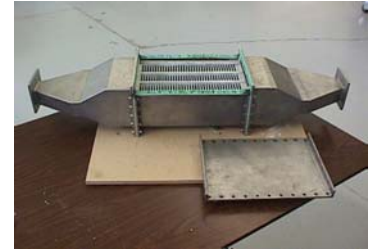
During FY 2002, ICS produced a pleated filter that exhibits only one-twentieth the backpressure of the previous wall-flow filter configuration. ICS developed technology that uses a ceramic binder to pleat the fibrous filter paper. The pleated filter was evaluated on a 1.7-liter Mercedes diesel engine in an ORNL test cell, and demonstrated 96 to 98% particulate removal efficiency with a low backpressure. A fully automated microwave filter system with the flat, pleated filters is being installed on the Ford truck for a 7,000-mile controlled test track evaluation, with periodic Federal Test Protocol cycle emission testing. Data from these on-road tests will be used to improve the performance of the microwave-regenerated particulate filter, verify system durability, and precisely quantify the fuel penalty resulting from filter operation.

Commercialization

Positive results from these tests should lead to product development partnerships with exhaust system suppliers, engine builders, or vehicle manufacturers. These strategic partnerships can move this technology to integration into a total commercial diesel exhaust emissions control system for pick-up trucks, sport utility vehicles, and large trucks.

Benefits

- Demonstrated average particulate removal efficiency of 97% over a range of operating conditions
- Potential solution to operating regimes where current diesel catalyst technologies are ineffective
- Works with both small and large diesel engines



Exhaust module with flat pleated diesel particulate filter



Debugging pleated particulate filter module on Ford F-250 exhaust system

For more information on how ORNL is helping America remain Competitive in the 21st century, please contact:

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Success Story