

RESISTANCE SENSOR EMPLOYING THERMOPHORESIS FOR SOOT IN DIESEL EXHAUST



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Summary

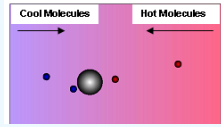
Soot source:
 ← Vehicles
 Candles →



To reduce particle emissions from diesel engines, sensors based on resistance change of soot collected on interdigitated electrodes have been introduced [1]. Sensitivity depends on the known mechanisms of soot deposition (convection, diffusion, impact and thermophoretic effects).

Thermophoresis is a force affecting particles suspended in a gas having a temperature gradient [2]. Collisions with gas molecules coming from the hotter zone result in net movement toward the colder zone for the particles. Sensor surfaces maintained at a cooler temperature than the exhaust gas will thus achieve an effective collection of soot particles less than 100 nm.

Thermophoresis show potential for high sensitivity soot sensing for applications such as OBD, On Board Diagnostics.



Thermophoretic Soot Sensor



Sensor mounting, 8 mm tube.



Finger electrode, resistive sensor.

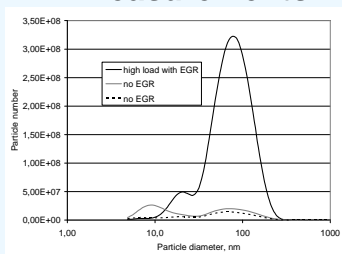


Finger electrode width/gap 150/100 µm.

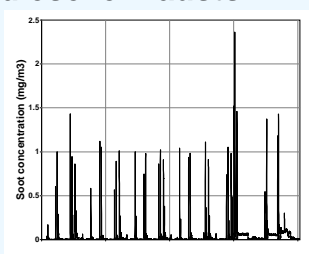


Sensor inserted in exhaust pipe.

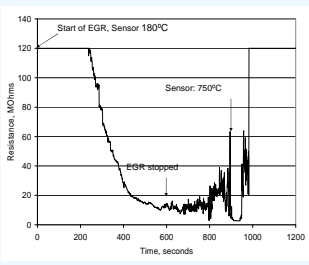
Measurements in diesel exhausts



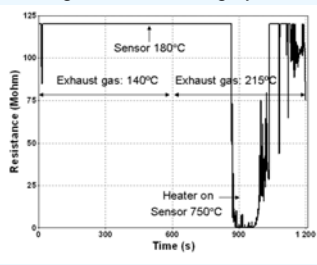
Particle size distribution of soot during high load conditions, EGR activated or disconnected



CMD (count medium diameter) accumulation mode soot concentration (weighted by mass) during EC2000 driving cycle

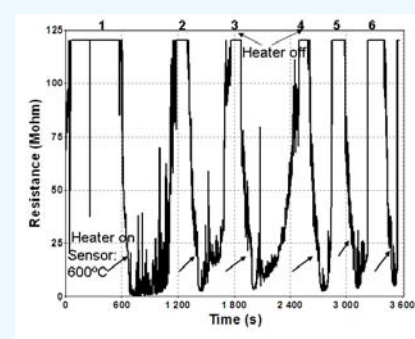


Sensor signal during steady-state driving of the stationary engine.



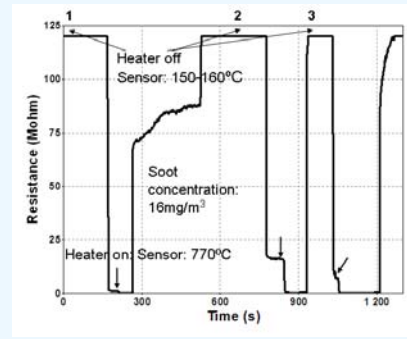
Sensor signal during E2000 driving cycle. Second half: high speed conclusion..

Measurements in diesel exhausts



Soot sensor signal during 6 cycles of soot collection and burn off

Soot concentration: 7-9 mg/m³
 Exhaust gas: 200-210°C
 Sensor: 150-160°C



Sensor signal during 3 cycles of soot collection and burn off

References

- [1] M. Fleischer, R. Pohle, K. Wiesner, and H. Meixner, "Soot Sensor for Exhaust Gases", Eurosensors XIX, Barcelona (2005).
- [2] W. C. Hinds, "Aerosol Technology: Properties, Behavior and Measurement of Airborne Particles", 2nd ed.; John Wiley and Sons, New York (1999); pp 54 and 216.