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.

Summary

Soot source:

- Vehicles
- Candles

Thermophoretic Soot Sensor

Sensor mounting, 8 mm tube.

Finger electrode, resistive sensor.

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.


Measurements in diesel exhausts

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

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Measurements in diesel exhausts

Soot concentration: 7-9 mg/m³

Exhaust gas: 200-210°C

Sensor: 150-160°C

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

Soot sensor signal during 3 cycles of soot collection and burn off

References