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**Diesel Particulate Matter Sensor:
Insights into the Effect of Corona Discharge on
Signal Amplification**

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Dr. Heejung Jung, Chairperson

In 2016, in-situ on-board diagnostic system for on-road vehicles is required to monitor particulate filter failure. The design of particulate matter (PM) sensors vary by company (e.g., Honeywell, Bosch, Emisense, and Delphi) in addition to method. The method under investigation in this study is electrical charge migration along with corona discharge generation.

Equilibrium charge state of particles (i.e., particle charging) is estimated using Boltzmann's Equilibrium Charge Distribution. The PM sensor design in this study is understood to generate a signal that is amplified higher than can be theoretically explained by the migration of oppositely charged particles. Signal amplification is hypothesized to be attributed to the presence of excess ions due to the presence of corona discharge, besides charged particles in an electric field. A fundamental study probing into the effects of corona discharge on PM sensor signal amplification is necessary to understanding the underlying operational principles of the sensor. This study will provide qualitative insights into the operating principles of the PM sensor by varying key parameters during testing. The influence of temperature, residence time, and particle concentrations were investigated to understand the behavior of the sensor.

This is performed by correlating sensor response to varying physical conditions of PM. A model of the sensor, without the corona discharge effect, will also be tested in comparable conditions to characterize the effects that are attributed to signal amplification of the PM sensor. Understanding the operational principles of this design could lead to the development of a relatively inexpensive PM sensor with unprecedented high signal sensitivity.