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Issue

Traffic-related emissions are divided into two general categories: exhaust- and non-exhaust-related. Due to decades of efforts to reduce exhaust-related emissions, the relative contribution from non-exhaust sources has increased. In contrast to exhaust-related emissions, non-exhaust sources are not well studied and their characteristics such as emission factors and associated health effects need more investigation. Previous studies have shown that the contribution from non-exhaust sources to PM10 (particulate matter with an aerodynamic diameter equal to or less than 10 micrometers) which can cause severe respiratory problems, is approximately equal to exhaust-related sources. The major contributors to non-exhaust particulate matter are brake and tire wear, while minor contributors include clutch and engine particle emissions.

Both brake and tire wear particles are rich in metallic content which has been found to cause various health effects ranging from pulmonary inflammation to cardiac responses. Therefore, one of the conventional methods for estimating brake and tire wear is to measure the trace metals emitted from brakes and tires in a lab, but real-time measurement in the field is not available with current measurement technologies.

Research Findings

In this project, researchers developed a portable computational imaging and deep-learning enhanced aerosol analysis device (c-Air) to identify and measure particulate emissions directly from traffic sources. Time-lapsed holograms of continuously collected particles emitted by a moving vehicle were taken using the c-Air device. Researchers found that significantly higher numbers of particles were collected per second when the car was in motion compared to the background particle levels measured when the vehicle was stationary. In addition, even more particles were generated during acceleration and braking. These results were in agreement with measures obtained from traditional aerosol sampling instruments.

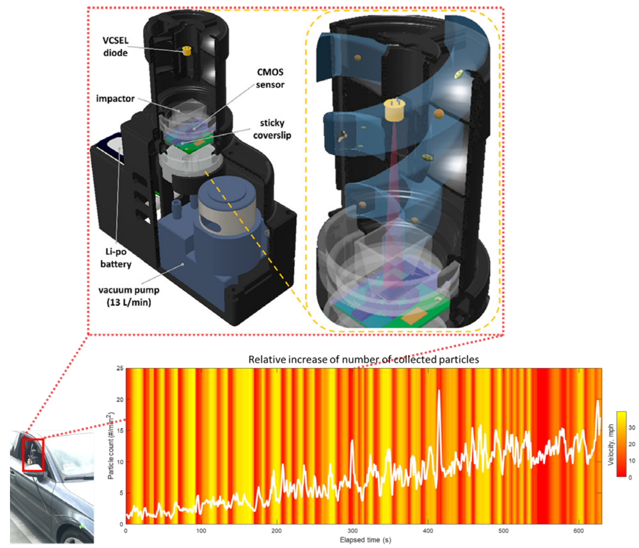

Figure 1. A mobile and cost-effective computational technology to analyze brake and tire wear emissions

Conclusions

This mobile and cost-effective device is able to distinguish non-volatile as well as volatile and evaporating particles caused by brake and tire wear generated by a moving vehicle from background road dust, with a high degree of accuracy in the field. In addition to counting and sizing particles, this system can also classify particles based upon physical features, shape, color and volatility using computational imaging and deep learning.

More Information

For more information, please contact Professor Aydogan Ozcan at ozcan@ucla.edu.

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