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A low-maintenance optoacoustic sensor for black carbon monitoring

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Supplemental Information

Correlation plots showing lines of best fit for the illumination-detection separating sensor (IDSS) and the control sensor:

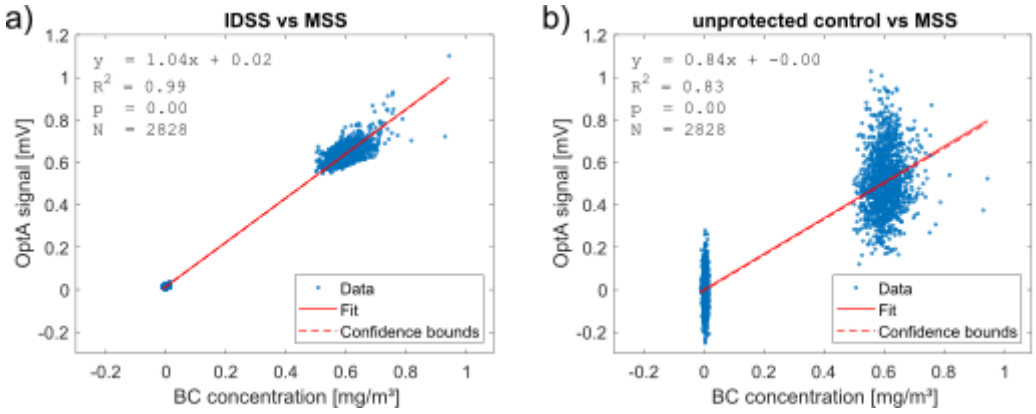

Figure S1: Correlation of the measurements presented in Fig. 4 between the AVL Micro Soot Sensor (MSS) and two optoacoustic (OptA) sensors. The illumination-detection separating sensor (IDSS) is shown on the left, and the unprotected control is shown on the right. The raw signals from the OptA sensors are plotted in mV, while the readouts from the AVL MSS are presented in mg/m^3. Each graph includes 2828 data points that were taken during the experiment. A line of best fit with confidence bounds is included for each figure. Two groups of points can be distinguished, one roughly at 0 mg/m^3 for the flushing period and one at 0.6-0.7 mg/m^3 during black carbon (BC) measurements. The line of best fit for the IDSS (left) has a R^2 value of 0.99. For the unprotected control sensor (right) the vertical spread of values on both sides of the line of best fit is quite large and the fit has a significantly lower R^2 value of 0.83. These lines of best fit were used to convert the raw signals from both OptA sensors to BC concentrations.

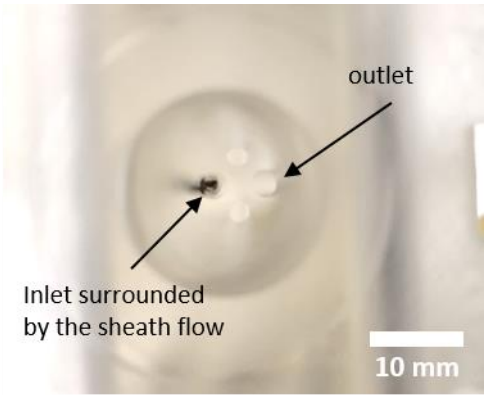

Figure S2: Picture of the ellipsoidal chamber of the optoacoustic illumination-detection separating sensor (IDSS) after the stress test presented in Fig. 3a. The openings for the sample flow (inlet and outlet) are shown. The sample inlet is visibly black, due to deposition of black carbon (BC) particles inside the inlet sensor tube. The rest of the chamber does not show any visible BC particle deposition. This is one more indication that the protective sheath flow effectively limits the diffusion of particles inside the sensor chamber and prevents contamination of sensitive components despite high BC exposure.