Mobile Environmental Exposure Personal Sensors

NSF SBIR Grant 1913409

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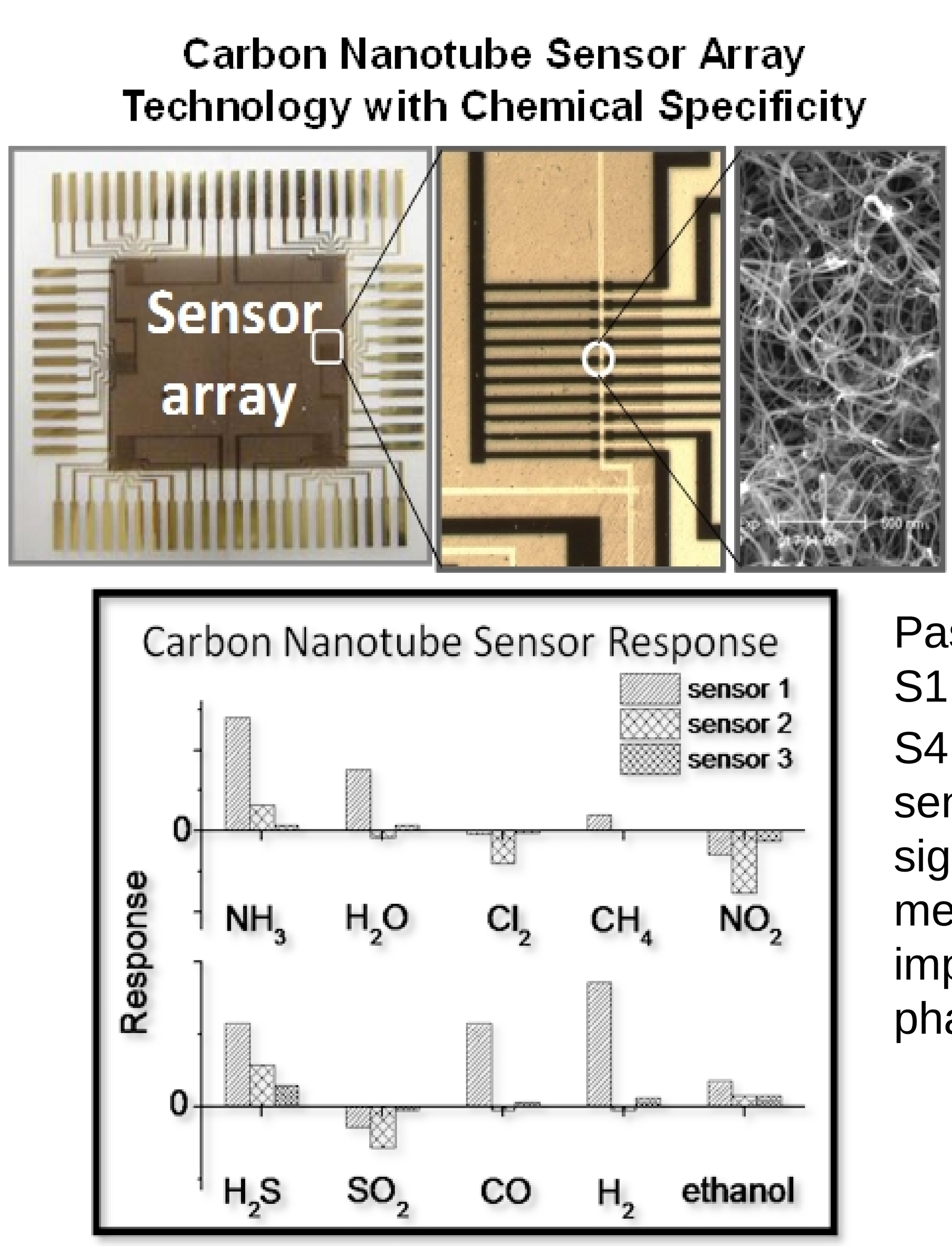
Abstract: Carbon nanotube (CNT) sensors offer sensitivity, compactness and low-power operation, thus providing a versatile platform for ambient monitoring of environmental hazards to public and occupational health. Our research focuses on nanotechnology-based mobile, wearable sensor arrays to detect airborne pollutants with known causative health effects on asthma (e.g., ozone, nitrogen and sulfur oxides, ammonia). These ambient monitors can also be configured as fixed IoT-type devices and integrated with wireless sensor networks to enable citizen science experiments in STEM education and collaboration among researchers. Our approach makes use of the unique electronic properties of CNTs and the tremendous potential to modulate their sensitivity and selectivity using tailored chemical functionalization with polymers, metals and metal oxides to adsorb specific molecules.



Passive sensor array (1"x1"). S1: Ozone, S2: NO_2, S3: NH_3, S4: Pristine CNTs. The four sensors are connected to a signal conditioning circuit which measures the transduced impedance (magnitude and phase) of each sensor.

Fig. 1. Illustration of a CNT-based sensor array. The sensing element produces a positive (negative) electrical signal depending on reducing (oxidizing) gas detection.

Functionalization improves performance

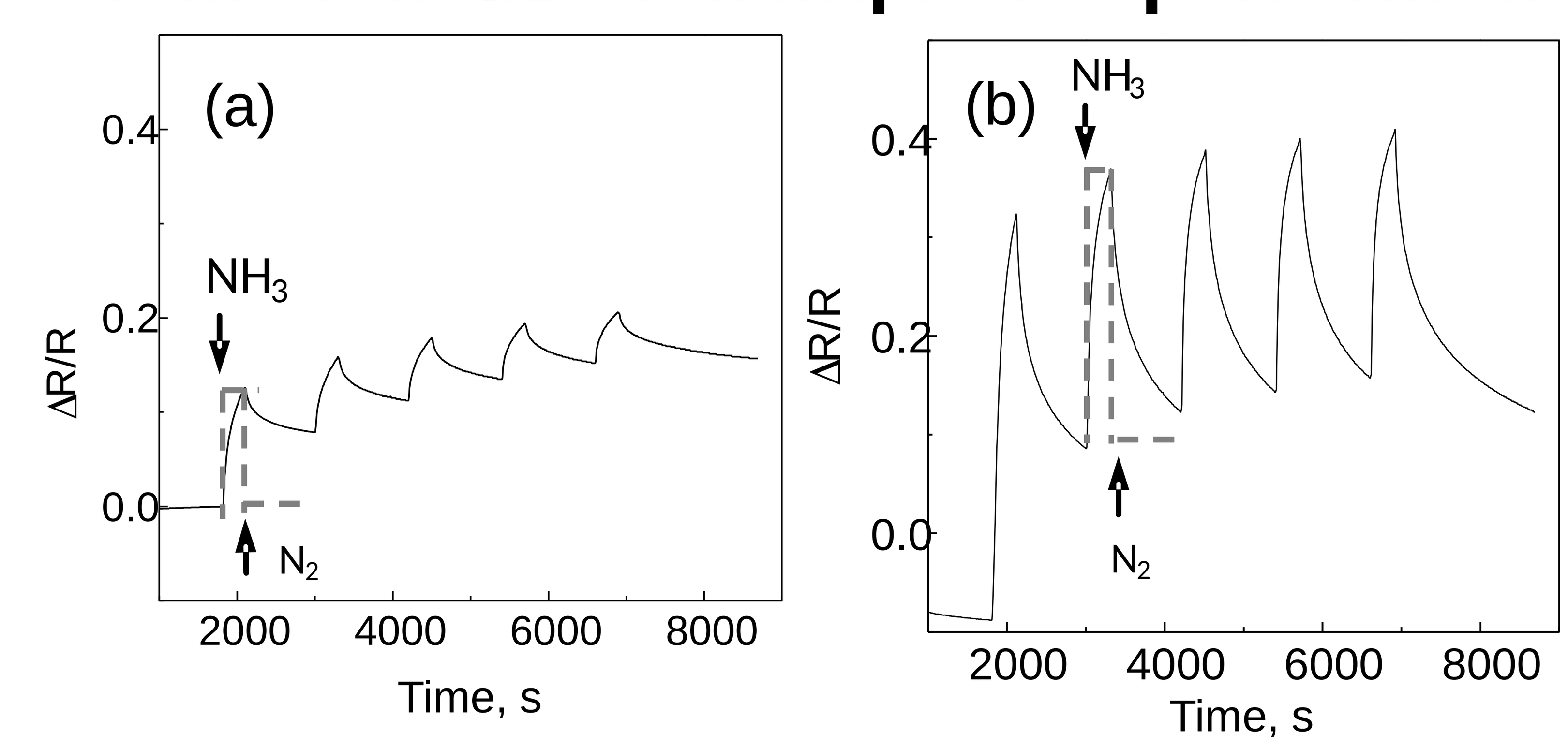


Fig. 2. Response curves of CNT sensors to 100 ppm NH_3. (a) pristine CNTs and (b) CNTs functionalized with poly(m-aminobenzene sulfonic acid). The latter show significant improvement in **repeatability, sensitivity and response time**.

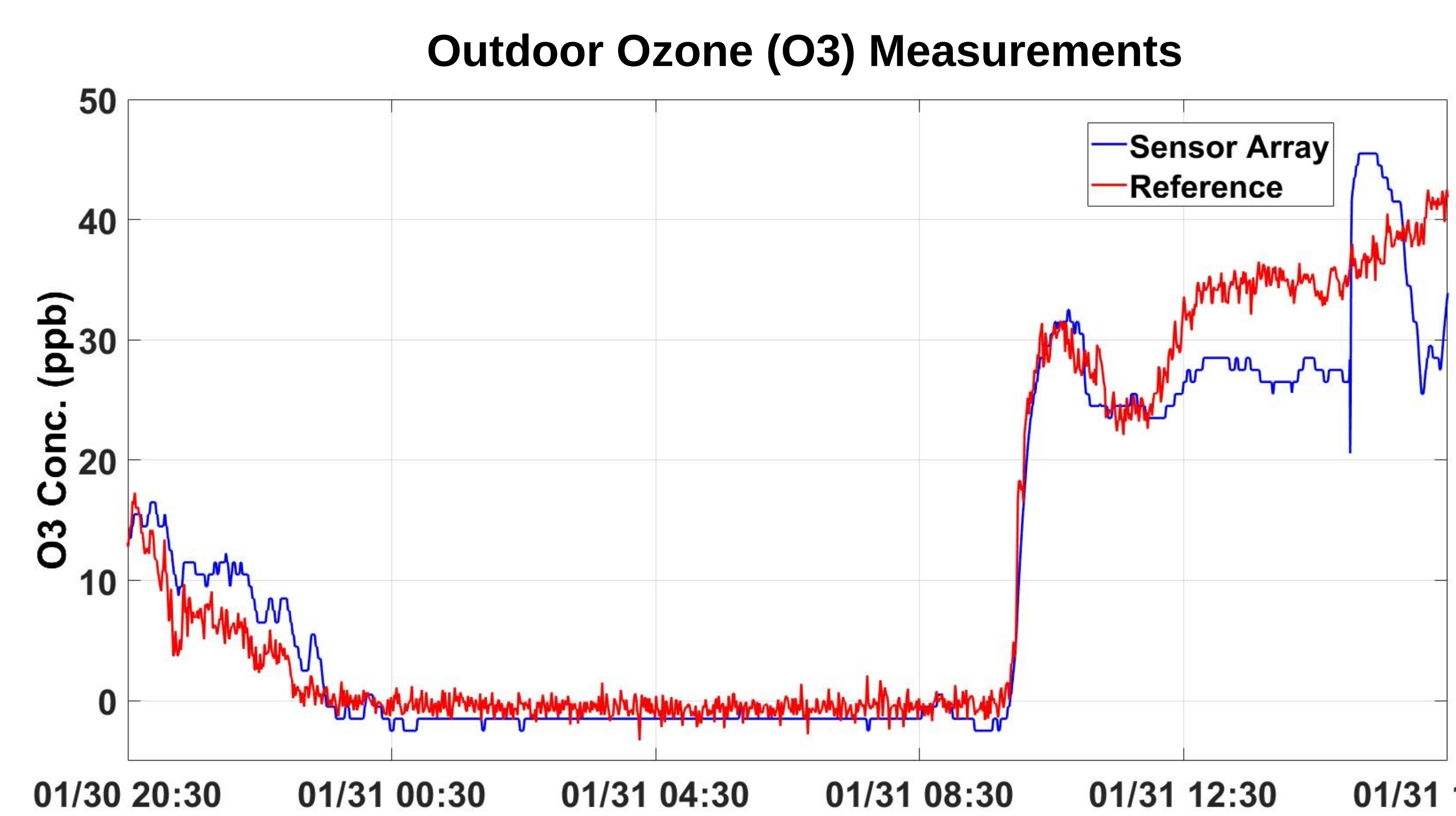


Fig. 3. The sensor array is calibrated in the laboratory and validated with ambient air measurements for ozone using a collocated EPA-standard reference instrument (2B Tech Model 202).

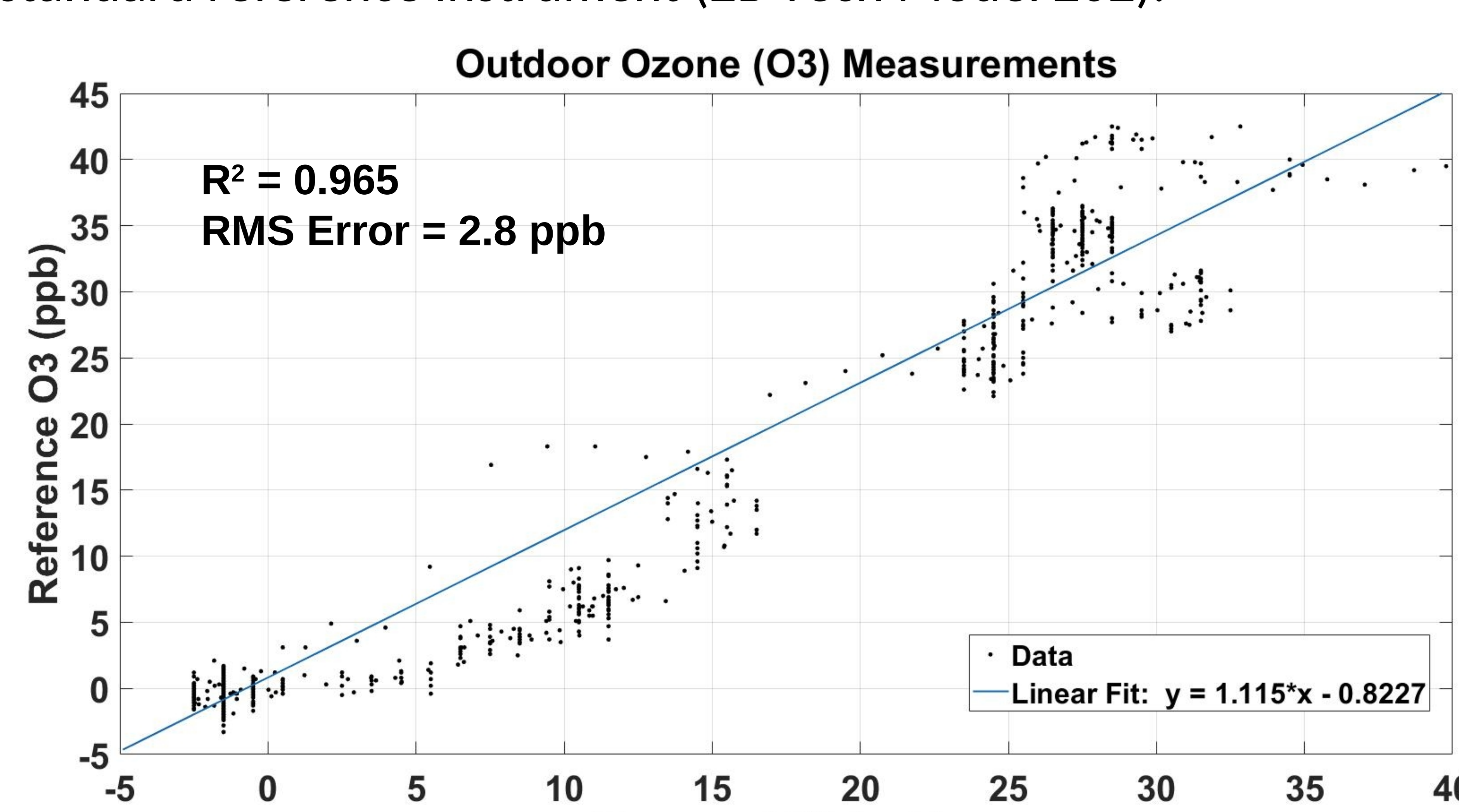


Fig. 4. Validation of sensor response against ambient ozone reference standard. The sensor measurements were taken near a busy road in Atlanta and corrected for humidity.