nature research

Corresponding author(s): James J. Collins

Last updated by author(s): Apr 29, 2021

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☒	☐	A description of all covariates tested
☒	☐	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☒	☐	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Two python-based executables for the Raspberry Pi Zero W were created, one for continuous stand-alone polymeric optic fiber signal acquisition, and another one for communication with blynk.io-based mobile application (Blynk Inc., New York, NY). The stand-alone sensing file "RPi_W_Python_CFFDWSB_V-1-0-7_A_Sens.py", and blynk.io-based mobile application code "RPi_W_Python_CFFDWSB_V-1-0-7_B_Blynk.py" are included in the supplemental information and utilize only newly developed code and the following open-source (MIT licensed) modules: matplotlib 3.1.2, openCV 4.1.2, Python-based RaspberryPi camera 1.3.0 and GPIO 0.1.0 modules (Raspberry Pi Foundation, Cambridge, UK), as well as python-based TLC59711 1.0.0 AS7262 1.0.0, CCS811 1.0.0, BME280 1.0.0 control's modules (Adafruit Industries®, New York, NY) and BlynkLib 0.2.5 from blynk.io (Blynk Inc., New York, NY).
Data analysis	Colorimetric images used ImageJ 1.52n to process the raw images for quantification. For fluorimetric or luminescent images, the images were processed by custom Python code. For LFA band intensity analysis, ImageJ 1.52n was used.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

All data needed to evaluate the conclusions in the paper can be found in the paper and the Supplementary Materials. Correspondence and requests for materials should be addressed to J.J.C.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	Sample sizes for the colorimetric wearables were selected at n=3 different sensors to provide a sufficient sampling of the performance of the designed devices and accounting for variations in lyophilization, rehydration, and reaction performance. For the fluorimetric wearable devices, each individual fiber optic bundle was treated as a data point, with 3 different reaction wells each with 3 POFs. For the SARS-CoV-2 face mask sensors, testing was performed on n=4 sensors for each variable on the benchtop or n=5 for each variable for on the breathing simulator apparatus.
Data exclusions	For the fluorescent and luminescent data, for each array of sensors (3 wells, 9 total optical fibers), the total average pixel intensity was calculated. Any fibers below 1 SD of the mean were excluded from final analysis. The hand-assembled SARS-CoV-2 face mask sensors were carefully inspected for fabrication errors (misaligned uPADs, crushed sensors during lyophilization and poorly assembled sensors) and these were excluded from the experiment.
Replication	Strict optimized procedures were taken to ensure lyophilization of the wFDCF reactions occurred similarly for all of the devices tested. All hydrated reactions were performed in temperature-controlled environments simulating human surface skin temperatures at ambient humidity to replicate field conditions. For the SARS-CoV-2 sensors, the microclimate of the mask was measured to maintain a temperature of 35C and relative humidity of 100% to simulate the microclimate inside of a human-worn facemask.
Randomization	For all our devices, each assembled fabricated device was inspected for damage to the fiber optics, uPADs, or material. Once it passed inspection, the devices were randomly chosen for experiments with the desired wFDCF reaction.
Blinding	Blinding is not relevant to our study. The data presented are quantitative values (see methods for how values were obtained) and did not require subjective judgment or interpretation. Blinding is not typically used in the field.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging