

## Supporting Information

### **Towards Quantitative Chemical Analysis Using a Ruler on Paper: An Approach to Transduce Color to Length Based on Coffee-Ring Effect**

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## **Chemicals and materials**

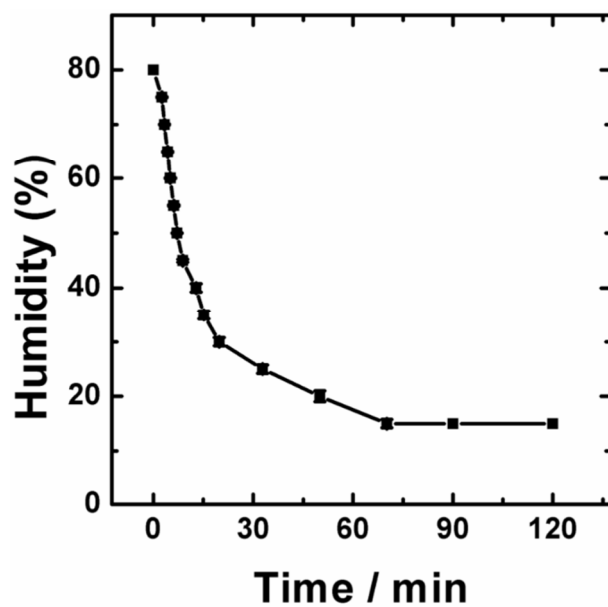
Glucose, glucose oxidase(GOx) from *Aspergillus niger* (100–250 U/mg) and 10 mM phosphate-buffered saline(PBS, pH 7.4) were purchased from Sigma-Aldrich. Starch-iodide paper (1 cm × 6 cm), sunset yellow, laminating film, glass slides, a sealed chamber and silica gel desiccant were obtained from Sinopharm Chemical Reagent Co.,Ltd (Shanghai, China). Double-sided adhesive tape was purchased from Soken Chemical& Engineering Co., Ltd (Tokyo, Japan). All solutions were prepared with deionised water (18.0 MΩ cm, Milli-Q Gradient System, Millipore). All reagents were used as received without further purification.

## **Experimental procedures**

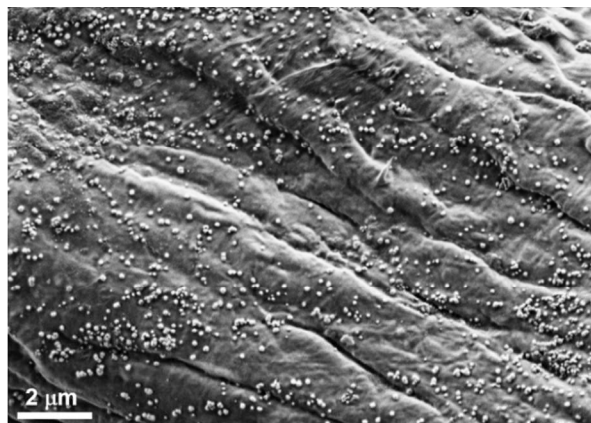
The starch-iodide paper was first attached to the double-sided adhesive tape and then patterned using a hole puncher into circle reaction reservoirs with a diameter of 6.0 mm. The patterned paper reservoirs were attached to a glass slide which was cleaned using acetone and ethanol. To prepare the paper reservoirs for the glucose detection, 4.0 μL aliquot of 10 mM PBS solution containing GOx at a concentration of 100 U/mL was spotted on the paper using a micropipette and allowed to dry at ambient conditions. Other than the circle paper reservoir, a paper strip (20×1.4mm) was used for the assay. The paper strip was fabricated by patterning the starch-iodide paper using a paper cutter. We also laminated the paper strip using an office laminator to improve the assay results. A hole in the middle of the lamination pouch was punched for introduction of assay

reagents and sample. Both ends of the paper strip were exposed to the air.

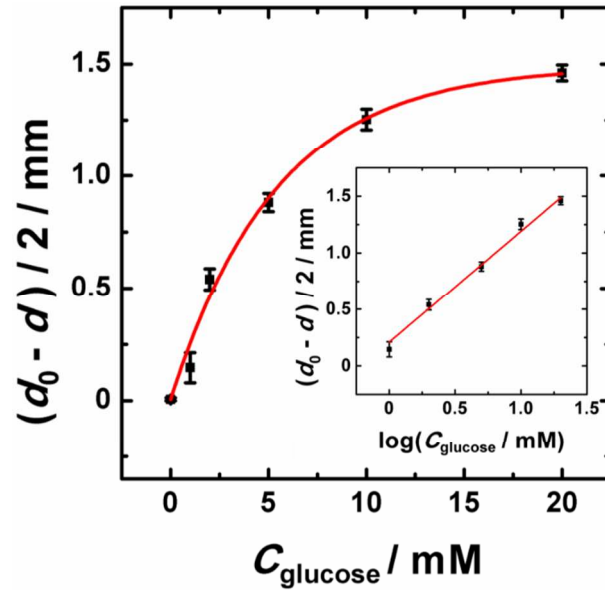
The homemade dry chamber is made of polypropylene, which is 25 cm(L), 17 cm(W) and 9.5 cm(H). About 150 g silica gel desiccant was included in one dry chamber. About 40 tests can be run at once in the chamber. The homemade dry chamber was used as the reaction chamber to maintain a constant humidity for all assays. After about 120 min, the relative humidity of the chamber was kept at about 17%, which was measured using a hygrometer. To initiate the assay, 4.0  $\mu$ L aliquot of the test sample containing glucose was dropcast onto the detection zone to react for 10 min and dry in the sealed chamber. An office scanner (BenQK802) with a resolution of 1200 DPI was used to obtain optical images of the paper reservoir. The color intensity of the detection reservoir was obtained from histogram of the selected area of the image imported into the Photoshop software.



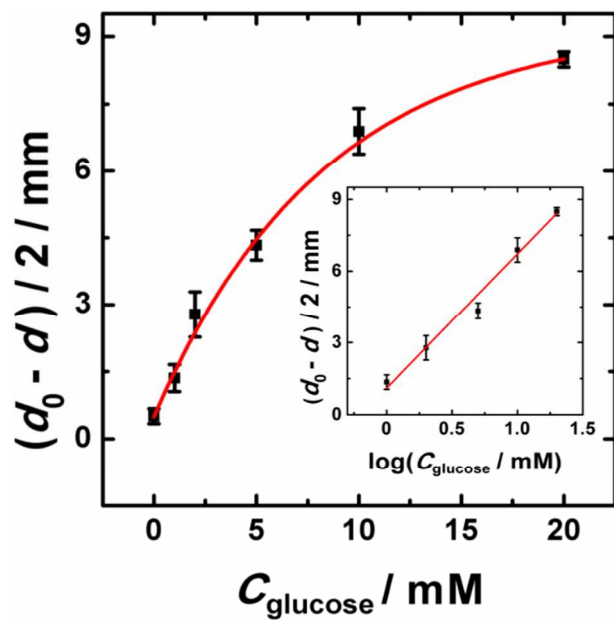
**Figure S1.** Relative humidity inside the sealed chamber as a function of time.



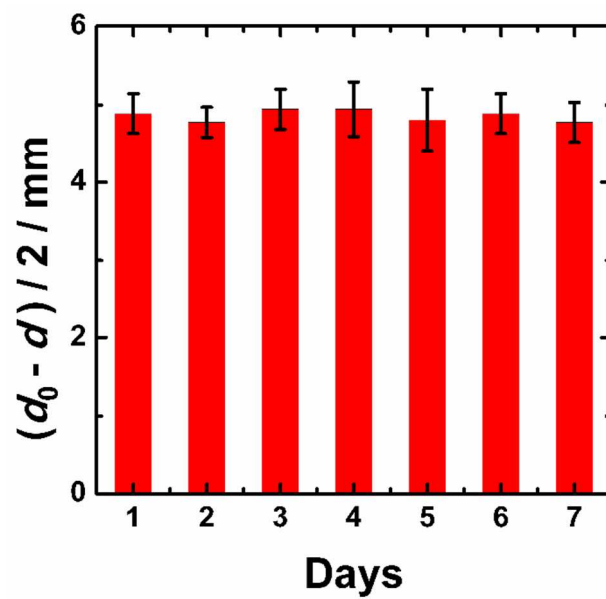
**Figure S2.** SEM image of the colored stain on the paper reservoir after completion of the assay.



**Figure S3.** Width of the colored ring  $(d_0 - d)/2$  as a function of glucose concentration. Inset: the width as a function of logarithm of the glucose concentration. The error bars represent standard deviation for three replicated measurements.

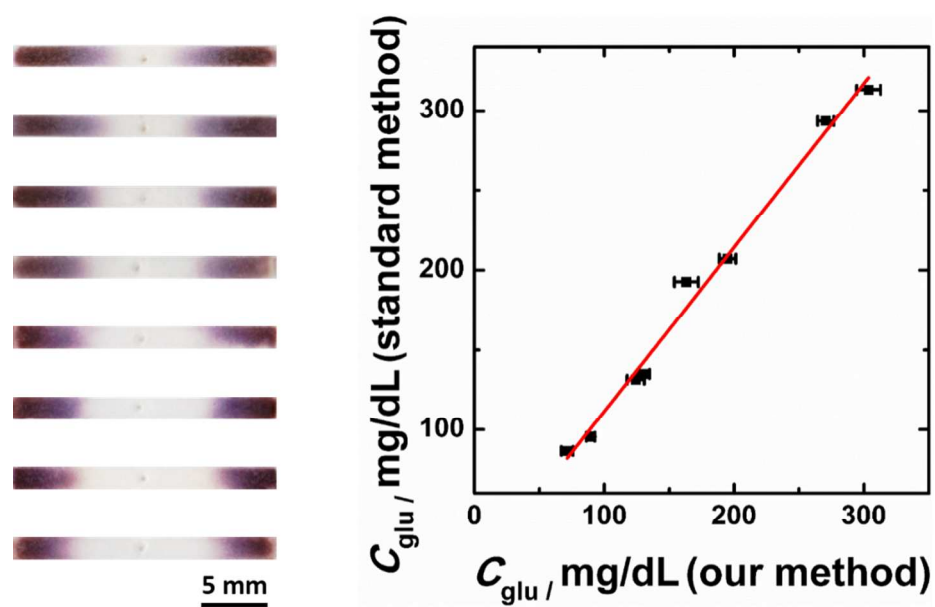


**Figure S4.** Width of the colored ring  $(d_0 - d)/2$  as a function of glucose concentration. Inset: the width as a function of logarithm of the glucose concentration. The error bars represent standard deviation for three replicated measurements.



**Figure S5.** The results of testing of the same sample in a week. The error bars represent standard deviation for 20 replicated tests.





**Figure S6.** The test results of plasma samples using our method and the results tested using a standard method.