Supplementary Information

A rapid and highly sensitive paper-based colorimetric device for the on-site screening of ammonia gas

Kawin Khachornsakkul[a], Hung Kuen-Hau[b], Jung-Jung Chang[b], Wijitar Dungchai*[a], Chih-Hsin Chen*[b]

a) *Department of Chemistry, Faculty of Science, King Mongkut's University of Technology Thonburi, Prachautid Road, Thungkru, Bangkok, 10140, Thailand.*

b) *Department of Chemistry, Tamkang University, New Taipei City 25137, Taiwan*.

Corresponding author: Asst. Prof. Dr. Wijitar Dungchai

E-mail: wijitar.dun@kmutt.ac.th

Corresponding author: Prof. Dr. Chih-Hsin Chen

E-mail: chc@mail.tku.edu.tw

Example calculation of 1.0 ppmv of NH_3 gas in this assay

From Eq.1; NH_4OH (aq) $\longrightarrow$ NH_3 (g) + H_2O (aq)

Mole of the NH_4OH is equal to NH_3 gas according to Eq. 1.

NH_3 gas at 1.0 ppmv was prepared from 0.8 nM of aqueous NH_3 solution according to below calculation;

From Eq.2; ppmv = µL of analyte gas / L of total air

In our experiment, we used the vial headspace, as a gas generation container, with 20.0 mL capacity.

Then; µL = 1.0 ppmv x 0.02 L

= 0.02 µL

Thus, L = 0.02 x 10^{-6} L

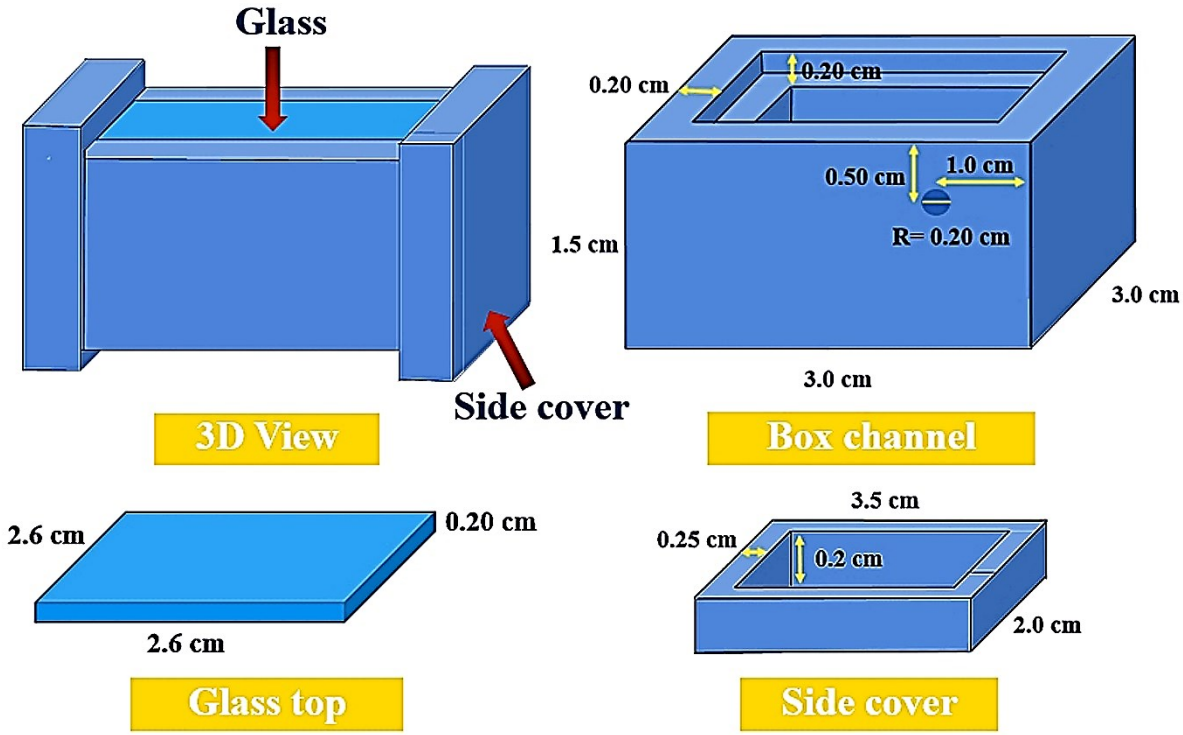
Next; we calculated the volume (V; L) of gas from aqueous solution by Eq. 3;

V = [$mol_{analyte}$ x 8.314 (L kPa/mol K) x 293.15 K] / 101.325 kPa

Then; $mol_{analyte}$ = [0.02 x 10^{-6} L x 101.325 kPa] / [8.314 (L kPa/mol K) x 293.15 K]

= 0.83 nmol

Therefore, we prepared the gaseous NH_3 at 1.0 ppmv by the introduction of 300.0 µL (0.30 mL) of aqueous NH_3 solution at 2.80 µM in the 20.0 mL of vial headspace and left to stand for 3 mins within a temperature as 25 ºC and normal pressure, standard temperature pressure; STP.



Scheme S1. Demonstrated the fabricated device for NH_3 gas detection in the proposed method.

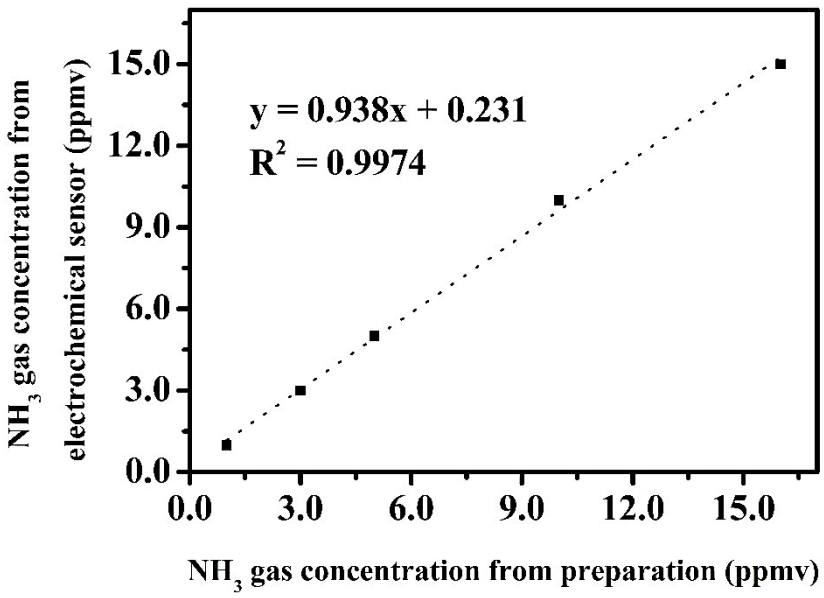


Figure S1 The linear plot of NH_3 gas concentration between the proposed preparation and electrochemical sensor.

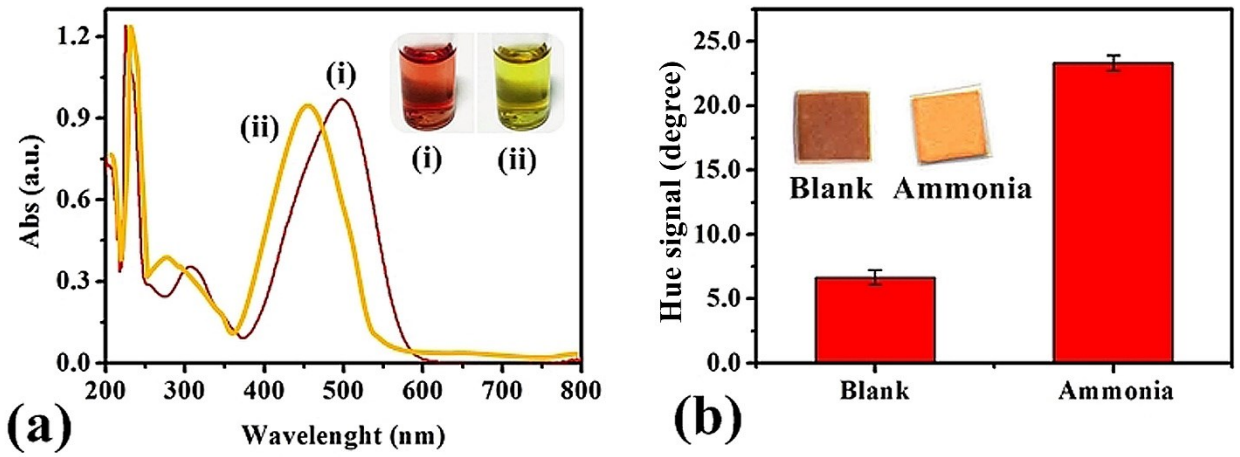


Figure S2. (a) The absorption spectra and corresponding images of methyl orange aqueous solution (i) without and (ii) containing 12.0 ppbv of NH_3 gas. (b) comparison of the hue signal for (i) air and (ii) 12.0 ppbv of NH_3 gas with the developed PADs in this method (n=3).