











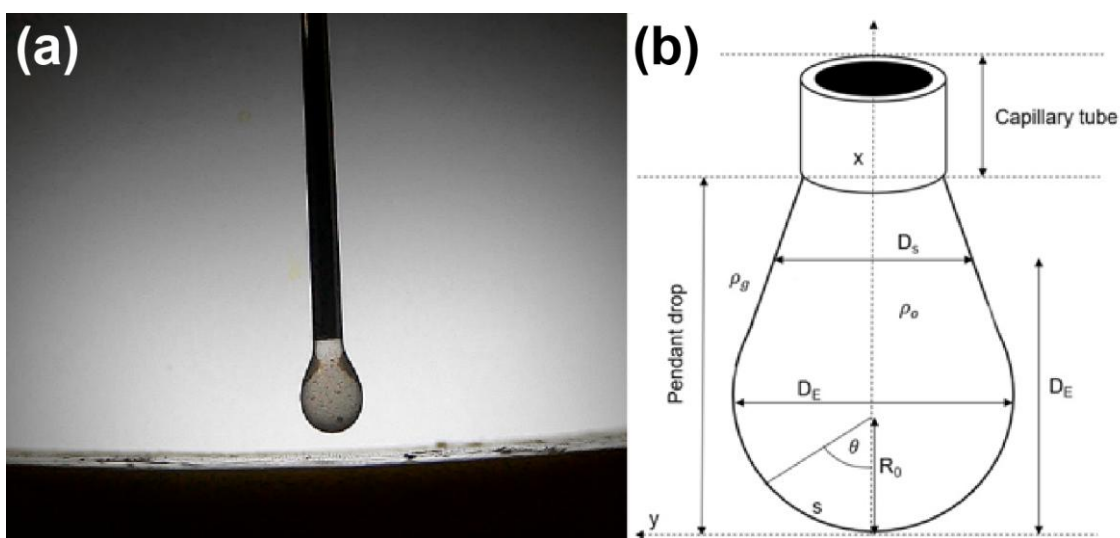


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5 Supplementary material to6 **Graphene-supported Pd/Pt nano-catalysts for enhanced**
7 **colorimetric detection of dopamine and NADH using paper-**
8 **based microfluidic devices**9 Ruri Agung Wahyuono^{1,2,*} , Jovin Jovin¹ , Ignacius Gilbert Chano¹ , Arda Fridua
10 Putra¹ , Annisa Septyana Ningrum¹ , Muhammad Yusuf Hakim Widiyanto³ , Irkham
11 Irkham⁴ , Yeni Wahyuni Hartati⁴ , Wulan Tri Wahyuni⁵ , Isnaini Rahmawati⁶ ,
12 Chi-Hsien Huang^{1,7}  and Yi-Ting Lai⁷ 13 ¹Department of Engineering Physics, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia14 ²School of Interdisciplinary Management and Technology, Institut Teknologi Sepuluh Nopember, Surabaya 60264,
15 Indonesia16 ³Department of Mathematics, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia17 ⁴Department of Chemistry, University of Padjadjaran, Sumedang 45363, Indonesia18 ⁵Department of Chemistry, Institut Pertanian Bogor (IPB) University, Bogor 16680, Indonesia19 ⁶Department of Chemistry, University of Indonesia, Depok 16424, Indonesia20 ⁷Department of Materials Engineering, Ming Chi University of Technology, New Taipei City 243303, Taiwan-21 ADMET & DMPK 14 (2026) 3247; <https://doi.org/10.5599/admet.3247>22 **Pendant drop test**23 Pendant drop test was carried out by measuring the diameter of fluid right before it drops from a capillary
24 tube. The diameter measured to calculate the surface tension is the maximum droplet diameter of (D_E) and
25 the diameter of the fluid right before it drops (D_S) as illustrated in Figure S1.26
27 **Figure S1.** (a) Pendant drop test with the (b) geometrical parameters

28 The surface tension was then calculated using Equation (S1):

29
$$\gamma = \frac{\Delta\rho g D_E^2}{\beta} \quad (\text{S1})$$

30 where $\gamma / \text{mN}\cdot\text{m}^{-1}$ is the surface tension, $\Delta\rho / \text{g}\cdot\text{cm}^{-3}$ is the density difference between fluid and air, D_E / cm is
 31 maximum droplet diameter as illustrated in Figure S1(b). The β is the shape factor of pendant drop expressed
 32 by Young-Laplace in the first order 3 dimensionless Equation (S2):

$$33 \quad \beta = 0.1284 - 0.7577 \frac{D_s}{D_E} + 1.7713 \left(\frac{D_s}{D_E} \right)^2 - 0.5426 \left(\frac{D_s}{D_E} \right)^3 \quad (\text{S2})$$

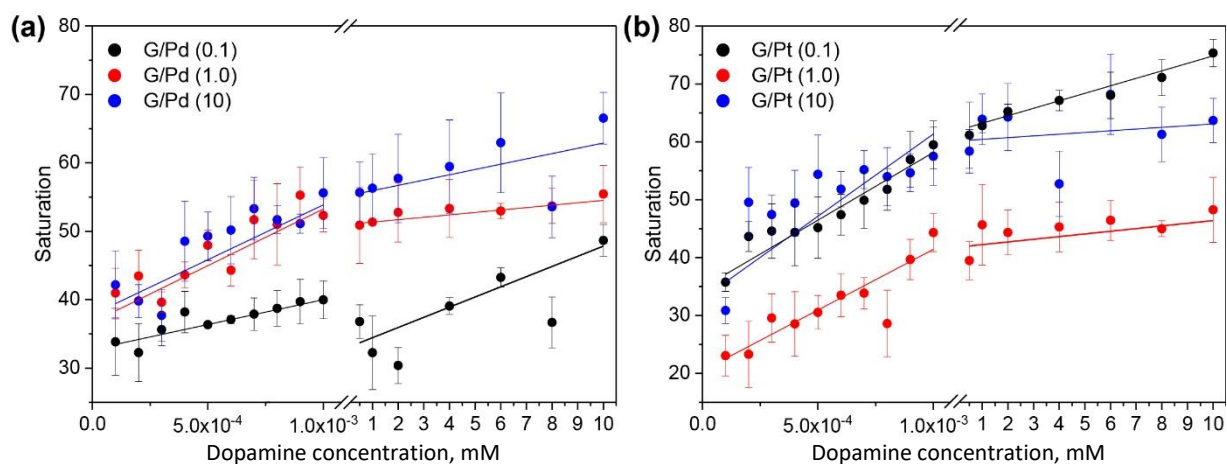
34 where D_s / cm is the necking droplet diameter. The calculated surface tension of G/Pt and G/Pd nanocomposite
 35 precursor solution is summarized in Table S1.

36 **Table S1.** Surface tension of various nanocomposite variations

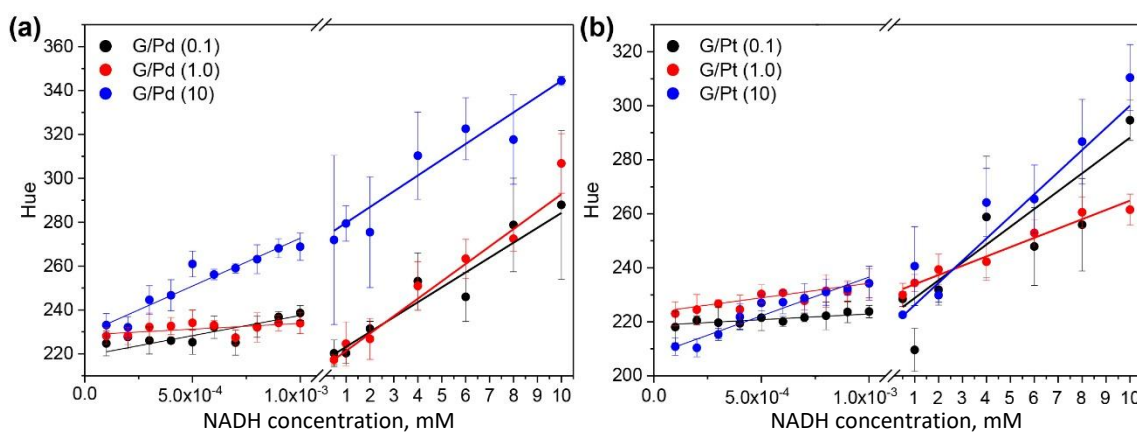
Precursor concentration, mM	Surface tension, mN m^{-1}	
	G/Pd	G/Pt
0.1	0.11	0.37
1.0	1.17	3.44
10.0	9.70	23.94

37 Calibration curve

38 As described in the main manuscript, both dopamine and NADH detection indicate two linear range, *i.e.*,
 39 the analyte concentration ranges between 0.1 to 1.0 μM and 0.5 to 10 mM as depicted in Figure S2 and
 40 Figure S3, respectively. These calibration curves were used to evaluate sensing performance evaluated in the
 41 main manuscript.



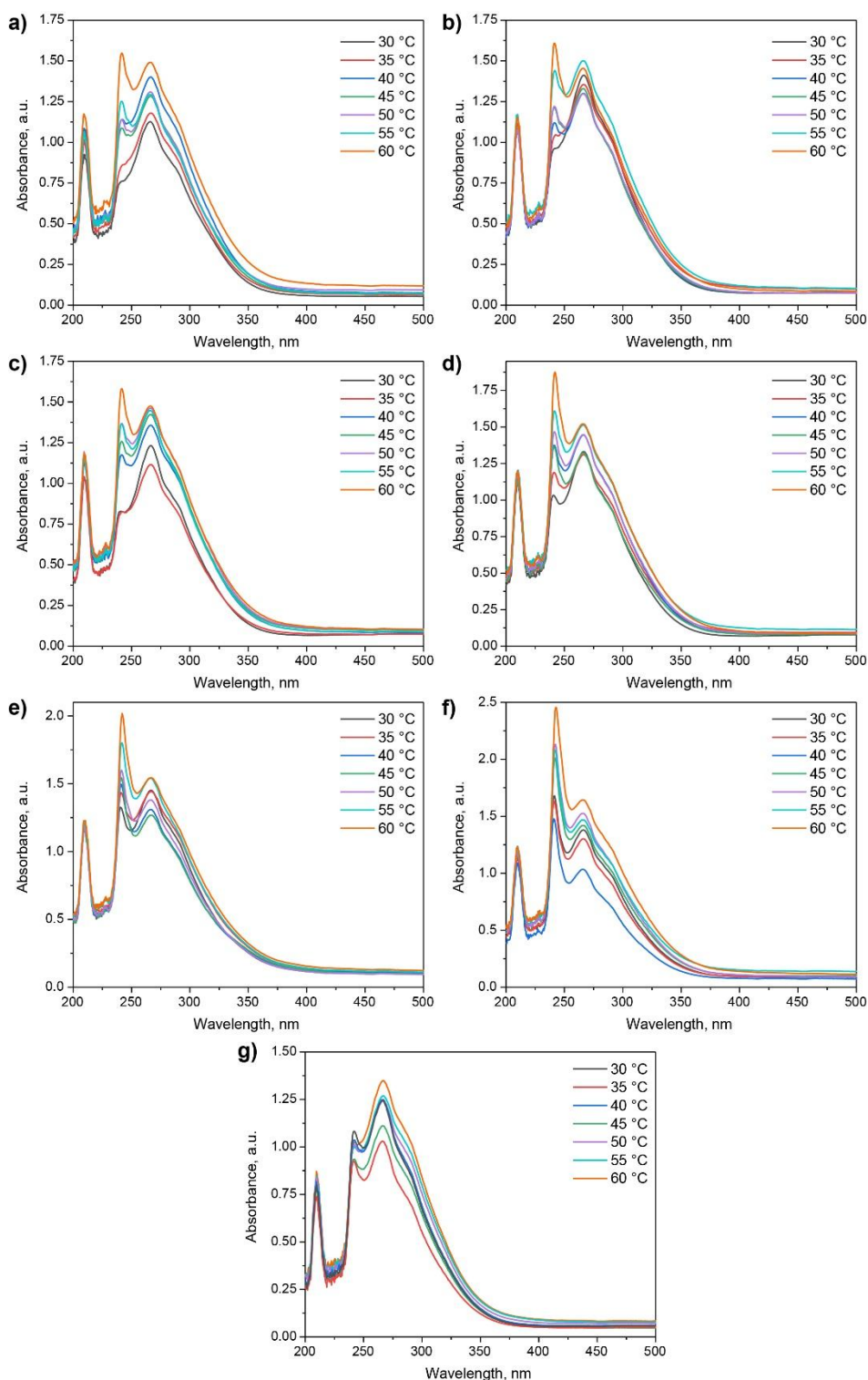
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44 **Figure S2.** Calibration curve of static response evaluation on dopamine detection using (a) G/Pd and (b) G/Pt
45 nanocomposite as catalyst



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48 **Figure S3.** Calibration curve of static response evaluation on NADH detection using (a) G/Pd and (b) G/Pt
49 nanocomposite as catalyst

50 **Temperature-dependent UV-Vis spectra**

51 To characterize the activation energy of G/Pd and G/Pt catalyst, temperature dependent absorption
 52 spectra of dopamine using different catalyst were recorded and shown in Figure S4.



53 **Figure S4.** UV-vis absorbance spectra of dopamine reaction with (a) G/Pd (0.1), (c) G/Pd (1.0), (e) G/Pd (10),
 54 (b) G/Pt (0.1), (d) G/Pt (1.0), (f) G/Pt (10) and (g) without catalyst at varying temperature.
 55

56 The activation energy is derived from the slope of $\log(A/A_0)$ vs. $1/T$ depicted in Figure S5. The Arrhenius
 57 plot is built from the absorbance change at the wavelength of 209.5, 241.5 and 266.5 nm which are indicative
 58 of metal nanoparticle interactions in graphene matrix. The activation energy from all wavelengths is
 59 summarized in Table S2.

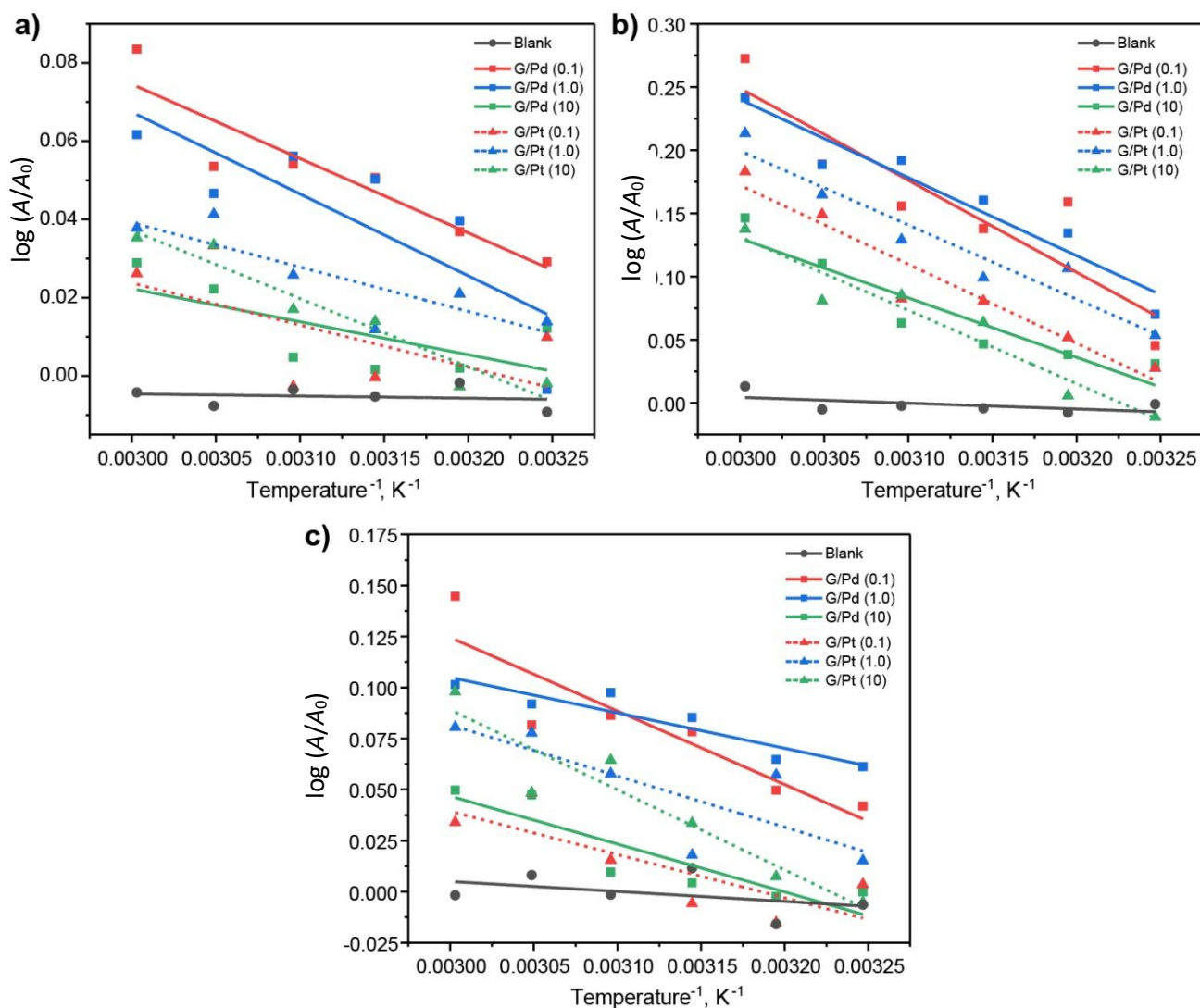


Figure S5. Arrhenius plot at (a) 209.5, (b) 241.5 and (c) 266.5 nm of G/Pd and G/Pt as colorimetric reaction catalyst

Table S2. Linear regression parameter of Arrhenius plot

Catalyst	Concentration of Pt or Pd, M	Slope, K			E_a / kJ·mol ⁻¹		
		209.5 nm	241.5 nm	266.5 nm	209.5 nm	241.5 nm	266.5 nm
G/Pd	0.1	-190.06	-727.54	-360.16	1.58	6.05	2.99
	1.0	-209.24	-617.99	-173.68	1.74	5.14	1.44
	10.0	-84.35	-470.76	-234.71	0.70	3.91	1.95
G/Pt	0.1	-107.53	-625.30	-211.88	0.89	5.20	1.76
	1.0	-113.44	-586.64	-250.50	0.94	4.88	2.08
	10.0	-174.47	-580.94	-392.38	1.45	4.83	3.26